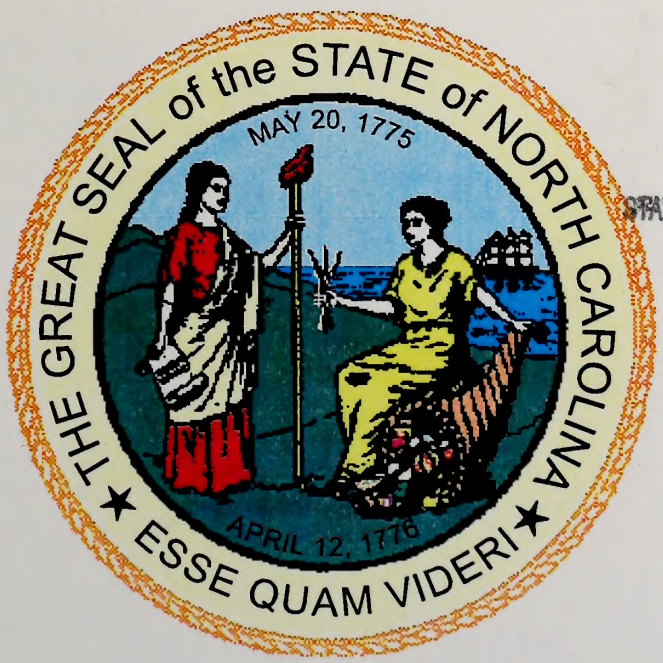
North Carolina Department of Transportation
Statewide Planning Branch
Urban Studies Unit

Highlands Thoroughfare Plan Technical Report



September, 1997

Thoroughfare Plan Report
for
Highlands, North Carolina

Prepared by the:

Statewide Planning Branch
Division of Highways
N. C. Department of Transportation

In Cooperation with:

The Town of Highlands
The Federal Highway Administration
U. S. Department of Transportation

11-20-97

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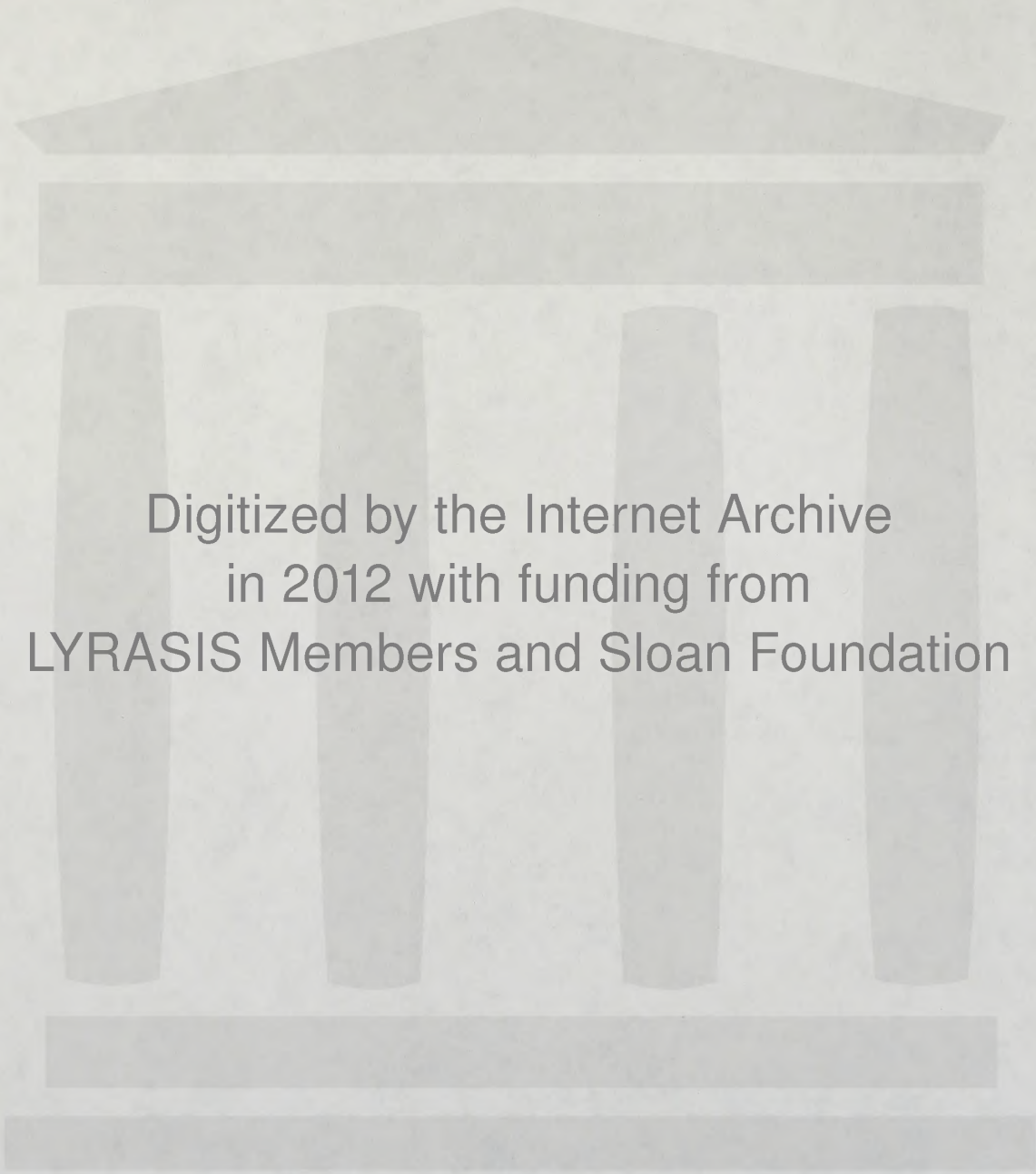

ACKNOWLEDGEMENTS

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1. Introduction

This report will document the proposed revisions to the 1991 Recommended Thoroughfare Plan. These revisions are a result of a request from the Town of Highlands to study projects which could reduce the number of trucks on, and alleviate congestion along, Main Street. Two basic project alternatives were studied. The first (Alternative #1) was proposed by the Highlands Planning Board. The second (Alternative #2) was a modification of a proposed project (Existing Alternative) on the 1991 Recommended Thoroughfare Plan. The recommended alternative (Alternative #3) is a further modification of Alternative #2 and is shown on the revised Recommended Thoroughfare Plan Map (Figure 2). All of the alternatives are shown in figure 3, (Project Alternatives) on page 11.

The remaining system of proposed thoroughfares was developed for the thoroughfare plan study following the basic principles of thoroughfare planning as described in Appendix A of this report. Major thoroughfares were located based upon existing and anticipated travel demands, existing streets, and field investigations. The plan advocates those improvements that are essential for proper traffic circulation within the current planning period (1996-2025).

Lastly, it should be emphasized that the recommended thoroughfare plan is based on the anticipated growth of the Town of Highlands and its surrounding area as described in this report. It is possible that the actual growth patterns will differ somewhat from those logically anticipated. As a result, it may be necessary to accelerate or retard the implementation of some portions of the plan and/or make revisions which will accommodate unexpected changes in urban development.

GEOGRAPHIC LOCATION FOR

THE TOWN OF HIGHLANDS

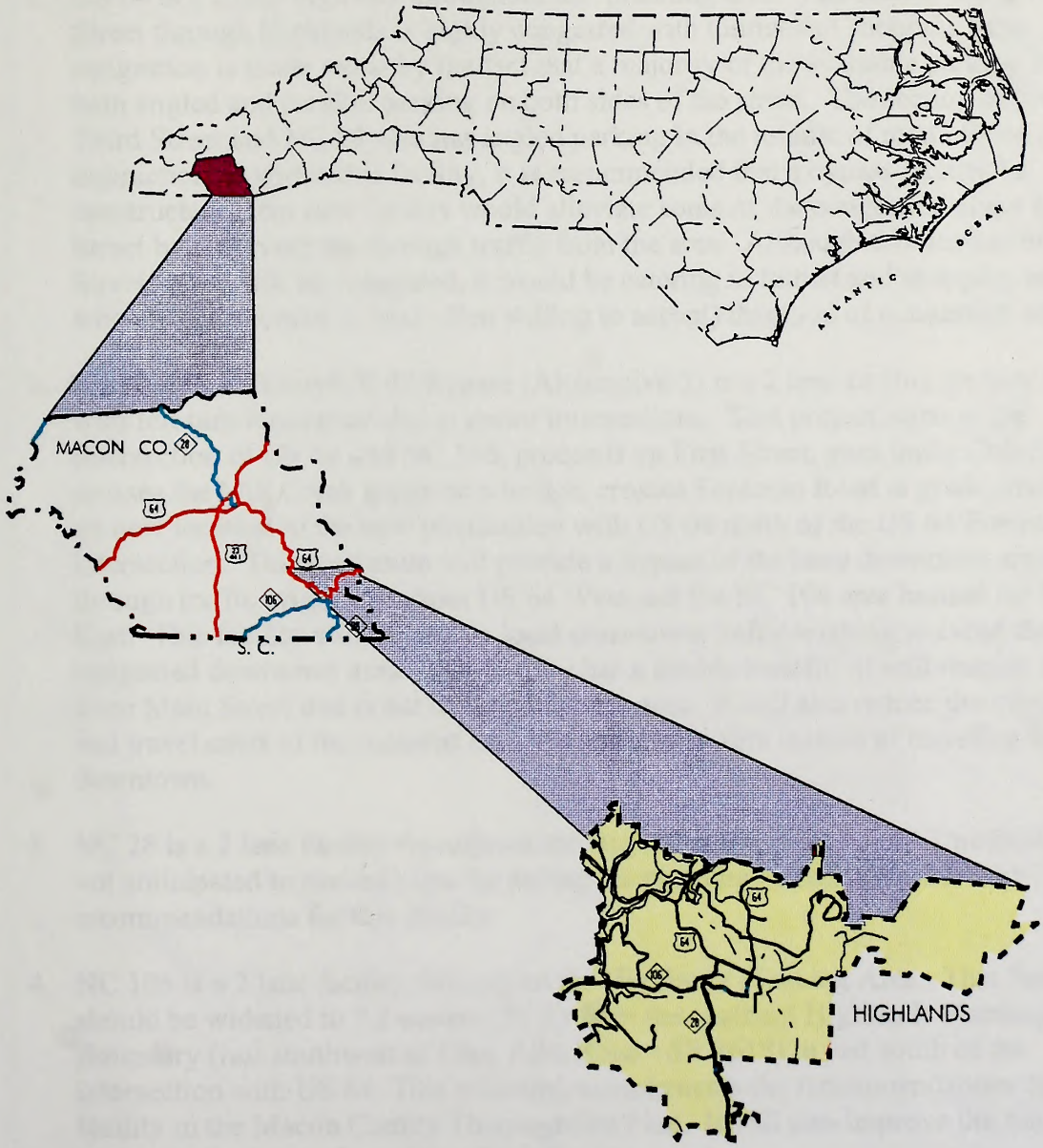


FIGURE 1

Minor Thoroughfares

1. Mirror Lake Road (SR 1546) is a 2 lane road that varies in width from 3.0 meters (10 ft) to 4.8 meters (16ft). It is recommended that this road be widened to 6.0 meters (20 ft) to improve the functional design and enhance the safety of this facility.

2. Hicks Road (SR 1545) is a narrow 2 lane road from the intersection with Mirror Lake Road to Flat Mountain Road. It is recommended that this road be widened to 6.0 meters (20 ft) to improve the functional design and enhance the safety of this facility.

3. Flat Mountain Road (SR 1544) is a 2 lane road that connects Hicks Road to US 64. It is recommended that this road be widened to 6.0 meters (20 ft) to improve the functional design and enhance the safety of this facility

4. Oak Street is recommended to receive a new bridge over First Street as a part of the construction of the Mill Creek Parkway/US 64 Bypass. There are no other recommendations for this road.

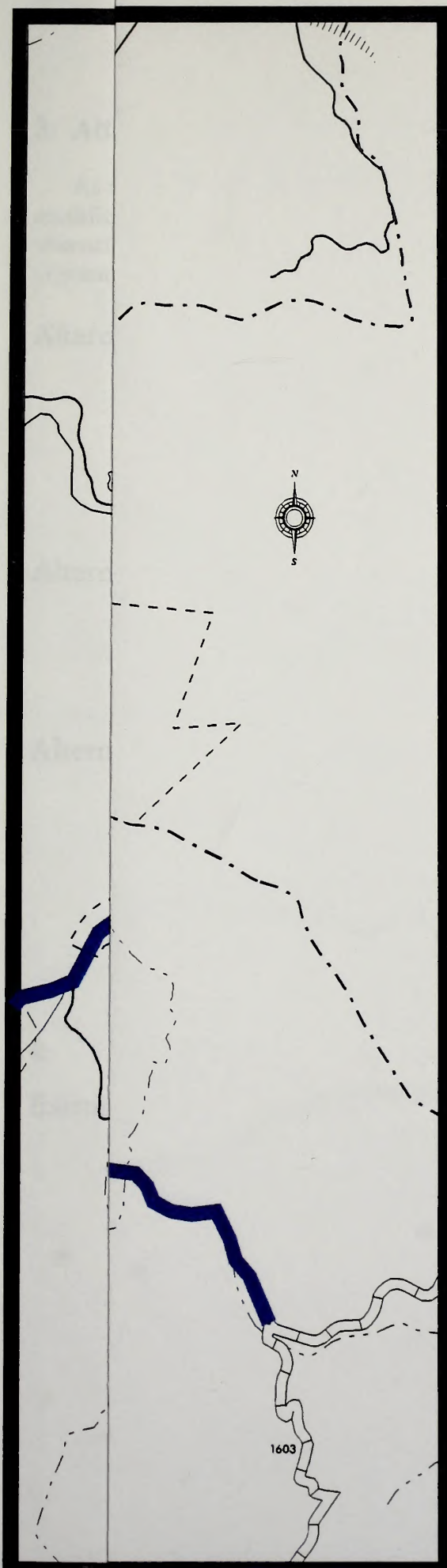
5. Third Street is not anticipated to exceed its capacity during the planning period. There are no recommendations for this facility.

6. Maple Street is a narrow 2 lane road that extends Third Street to US 64 West. It is recommended that this facility be paved and widened to 6.0 meters (20 ft) to improve functional design and enhance safety.

7. Spring Street is not anticipated to exceed its capacity during the planning period. There are no recommendations for this facility.

8. Chestnut Street (SR 1602) is not anticipated to exceed its capacity during the planning period. There are no recommendations for this facility.

9. Fifth Street is not anticipated to exceed its capacity during the planning period. There are no recommendations for this facility.



LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE		
MINOR THOROUGHFARE		
PROPOSED GRADE SEPARATION		

FIGURE 2

ADOPTED BY:

TOWN OF HIGHLANDS _____
MACON COUNTY _____
PUBLIC HEARINGS _____
_____
_____

RECOMMENDED BY STATEWIDE PLANNING _____

N.C. DEPARTMENT OF TRANSPORTATION _____

DECEMBER 13, 1996

RECOMMENDED THOROUGHFARE PLAN

HIGHLANDS

MACON COUNTY
NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 0.5 1.0
miles

0 1 2
kilometers

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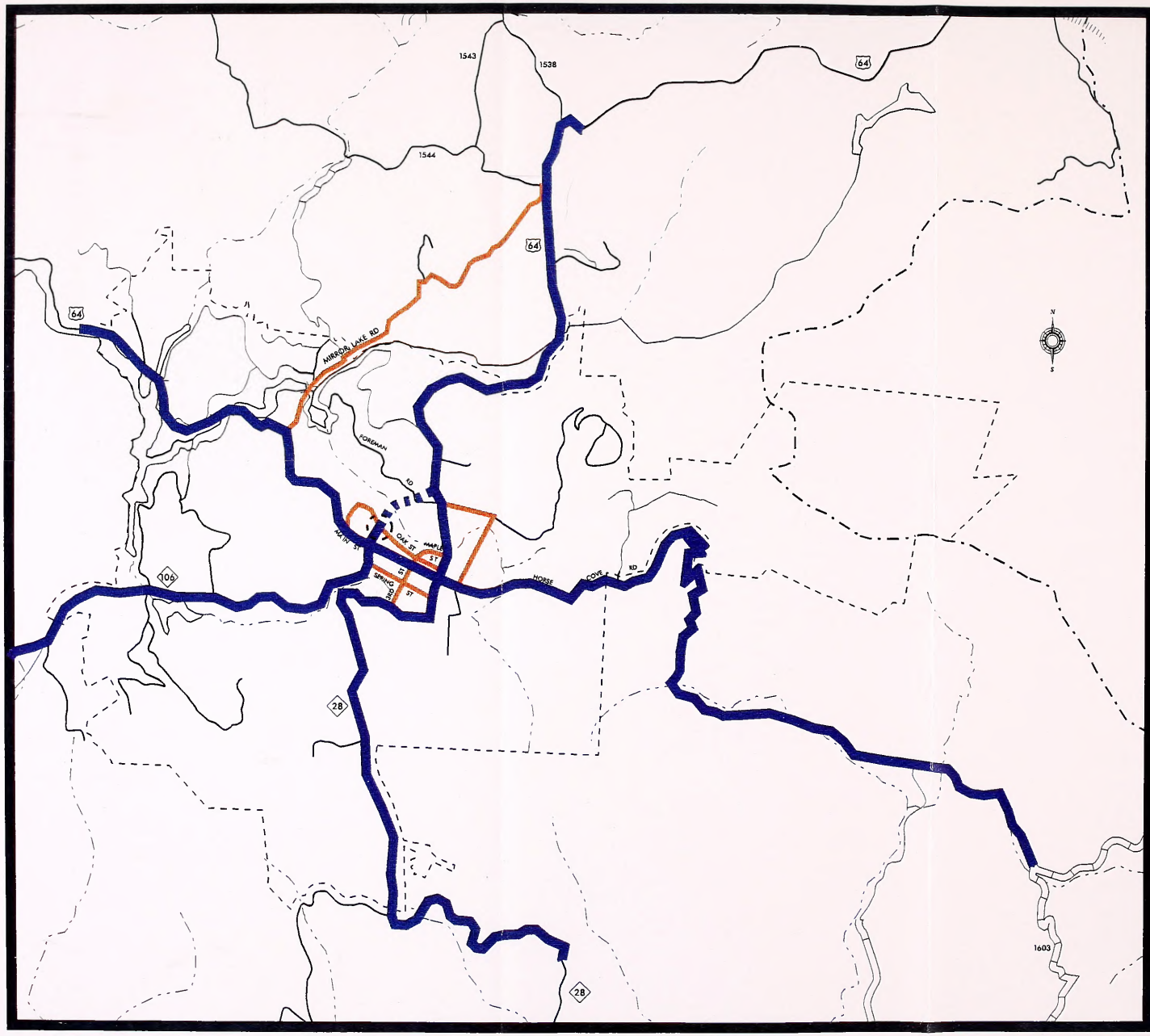


LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE	▬▬	▬ ▬ ▬
MINOR THOROUGHFARE	▬▬	▬ ▬ ▬
PROPOSED GRADE SEPARATION		○

FIGURE 2

ADOPTED BY:

TOWN OF HIGHLANDS _____
MACON COUNTY _____
PUBLIC HEARINGS _____
_____
_____

RECOMMENDED BY STATEWIDE PLANNING _____

N.C. DEPARTMENT OF TRANSPORTATION _____

DECEMBER 13, 1996

RECOMMENDED THOROUGHFARE PLAN

HIGHLANDS

MACON COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 0.5 1.0
miles

0 1 2
kilometers

3. Alternatives Analysis

As discussed in Chapter 1, there are only two basic alternatives. However, with slight modifications, we get two more alternatives to study. A brief description of each alternative is listed below. Figure 3 contains a map showing the location of all the alternatives.

Alternative 1: Proposed by the Highlands Planning Board, this alternative calls for some construction on new location and for improving portions of Oak Street and Maple Street to create a bypass of US 64 (Main Street). As discussed with the Planning Board, this alternative also includes the improvement of First Street from Main Street to Oak Street. This improvement of First Street provides for the extension of NC 106 to the new bypass. This is essential for system and traffic flow continuity.

Alternative 2: This is a modification of the proposed bypass project on the 1991 Recommended Thoroughfare Plan. It improves First Street from Main Street to Oak Street by widening it and by lowering the grade. It then crosses the Mill Creek gorge on a bridge and ties into Foreman Road just west of the City Park.

Alternative 3: This is the Planning Board's preferred alternative and alternative recommended by the Statewide Planning Branch of NCDOT. This alternative also improves First Street from Main Street to Oak Street and it uses a bridge to cross the Mill Creek gorge. However, to better improve the grade along First Street, this alternative incorporates the grade separation of Oak Street from the new bypass. This means that Oak Street would be carried over the new bypass on a bridge and that there would be no access to Oak Street from this new road. Also, by recommendation of the Planning Board, the bypass would cross Foreman Road at grade and go on new location across city property to tie into US 64 north of the current intersection of Foreman Road with US 64.

Existing Alternative : This is the proposed project on the 1991 Recommended Thoroughfare Plan. It improves First Street from Main Street to Oak Street and it provides a grade separation of Oak Street from the bypass. The bypass then travels down into the gorge, crosses Mill Creek on a bridge, and then works its way up to cross Foreman Road and then go on new location across city property to tie into US 64 north of the current intersection of Foreman Road with US 64.

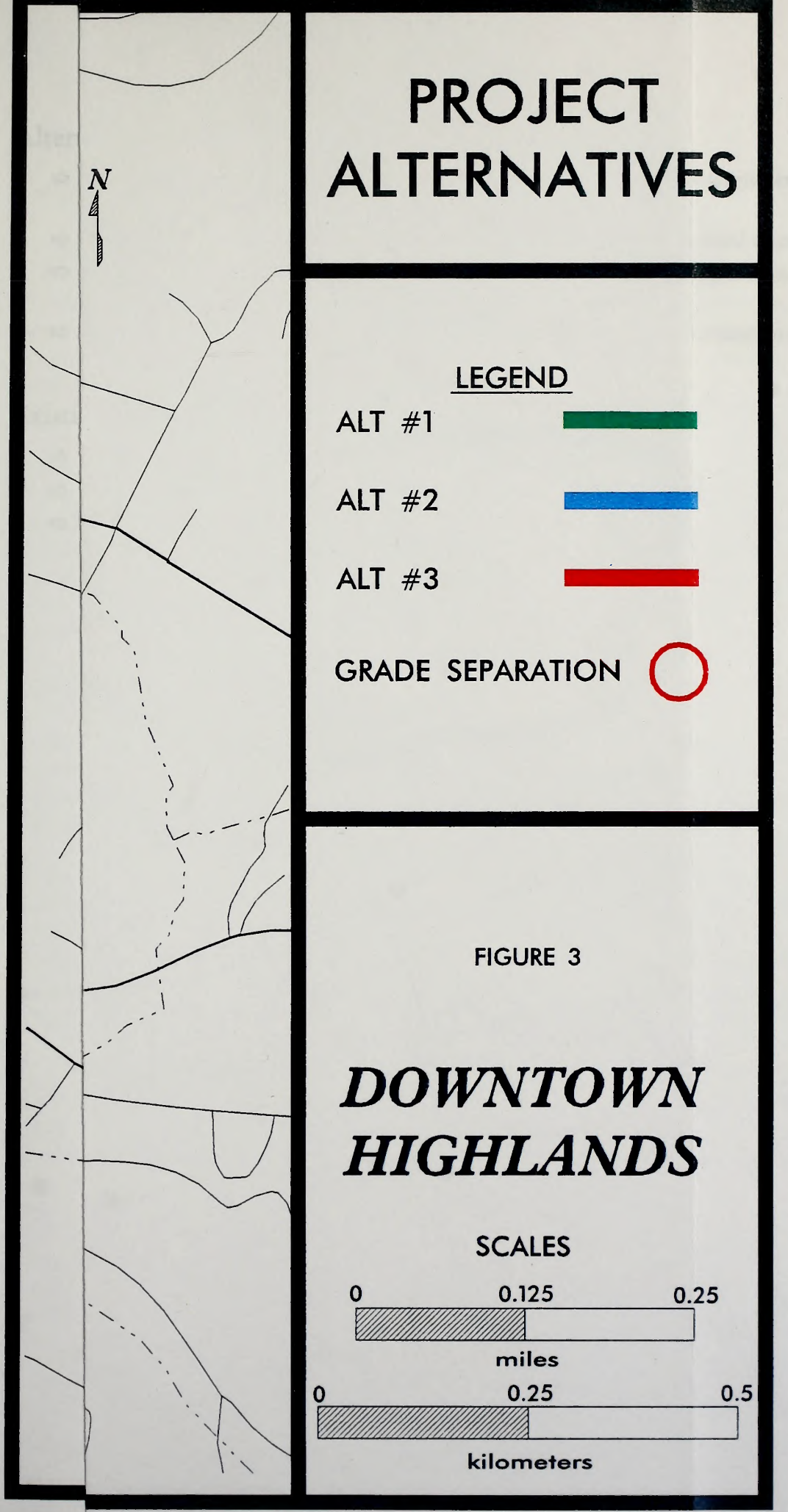
After studying the alternatives, the travel patterns, the surrounding terrain, and the location of existing and potential development; It is believed the only feasible and prudent alternatives that alleviate the traffic congestion along Main Street will be one of the alternates listed above. An analysis of each of these alternatives shows that all of them will take land from the City Park. Since this park was purchased using the Land and Water Conservation Fund; any taking of property purchased with these funds could fall under section 6f of the Land and Water Conservation Fund Act. Consequentially, the Statewide Planning Branch and the Highlands Planning Board studied each alternative closely to select the one that alleviates traffic congestion and also minimizes impact to the City Park. After careful consideration, the Highlands Planning Board selected Alternative 3 as it's preferred alignment and the Statewide Planning Branch concurs.

Alternative 3 is the recommended alternative shown on the revised Recommended Highlands Thoroughfare Plan in figure 2. Although this alternative splits the park, it does so on a high bridge (approximately 30 meters above Mill Creek) that would not change or adversely impact the existing use of the land it crosses. It provides a more direct bypass route and it takes the least amount of land from the park. The only land needed would be that required for the approximately 6 to 8 column foundations and possibly a temporary construction easement. A design incorporating the use of segmental concrete or curved girder steel construction could minimize the visual appearance of the bridge from the park. The inclusion of sidewalks and/or bike lanes on the bridge could also enhance the use of the bridge as well as promote the already strong tourism nature of the area. It is even possible that the park could work such a structure into its master plan.

There are several reasons that this alternative was chosen. The following is a list of the differences between the recommended alternative and the remaining alternatives.

Alternative 1

- ⇨ Although this alignment does not split the park, the widening of Oak Street could take more park land than alternative 3.
- ⇨ The land needed could be minimized by the use of a retaining wall; but, this will increase the project cost.
- ⇨ More businesses and homes are impacted by this alternative.
- ⇨ A potential historical structure and a possible archeological site are located in or near the alignment.
- ⇨ This alternative has a higher project cost than the recommended alternative.


N
PROJECT ALTERNATIVES
LEGEND
ALT #1
ALT #2
ALT #3
GRADE SEPARATION
FIGURE 3
DOWNTOWN HIGHLANDS
SCALES
0
0.125
0.25
miles
0
0.25
0.5
kilometers

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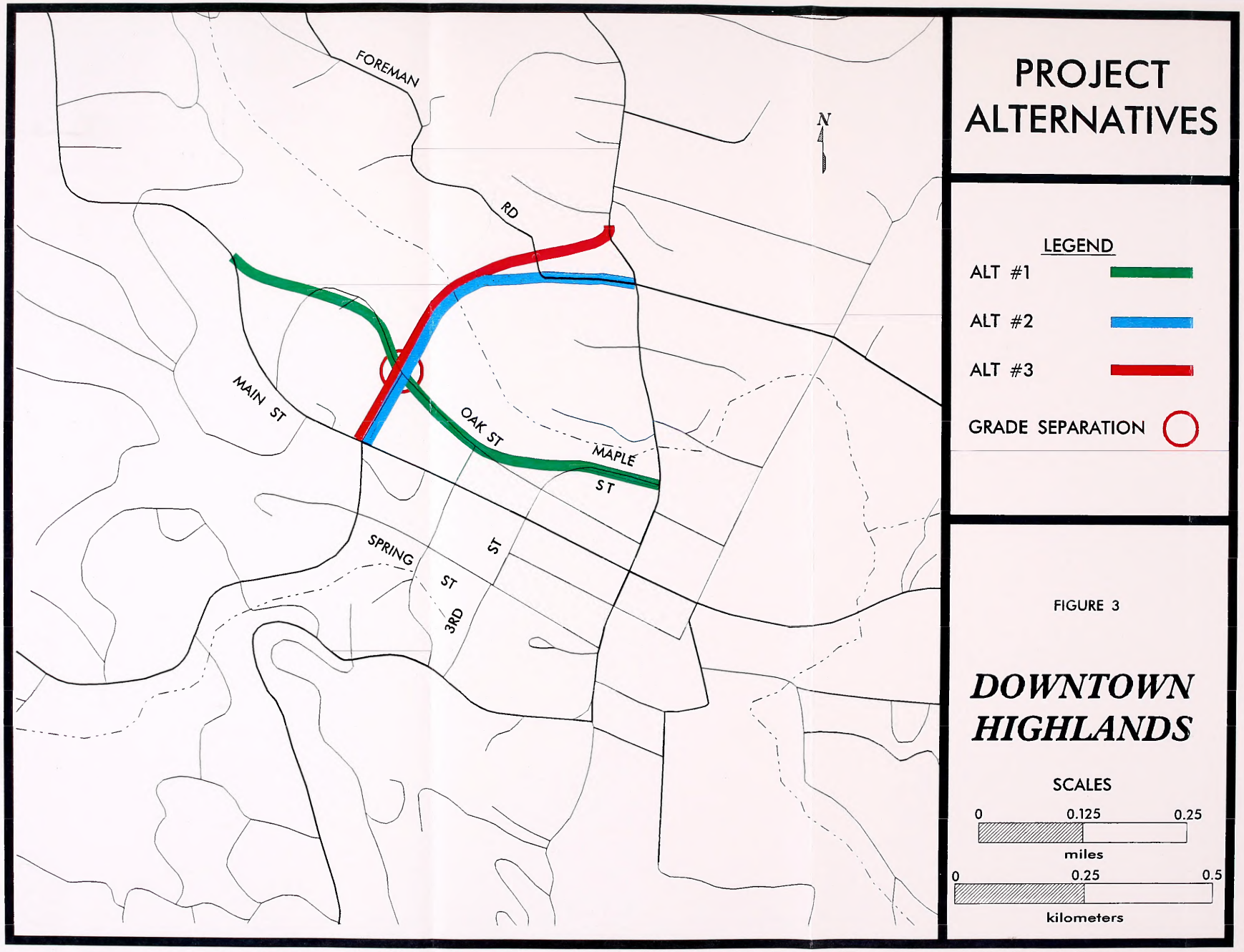
FOREMAN
RD
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MAPLE
ST
SPRING
ST
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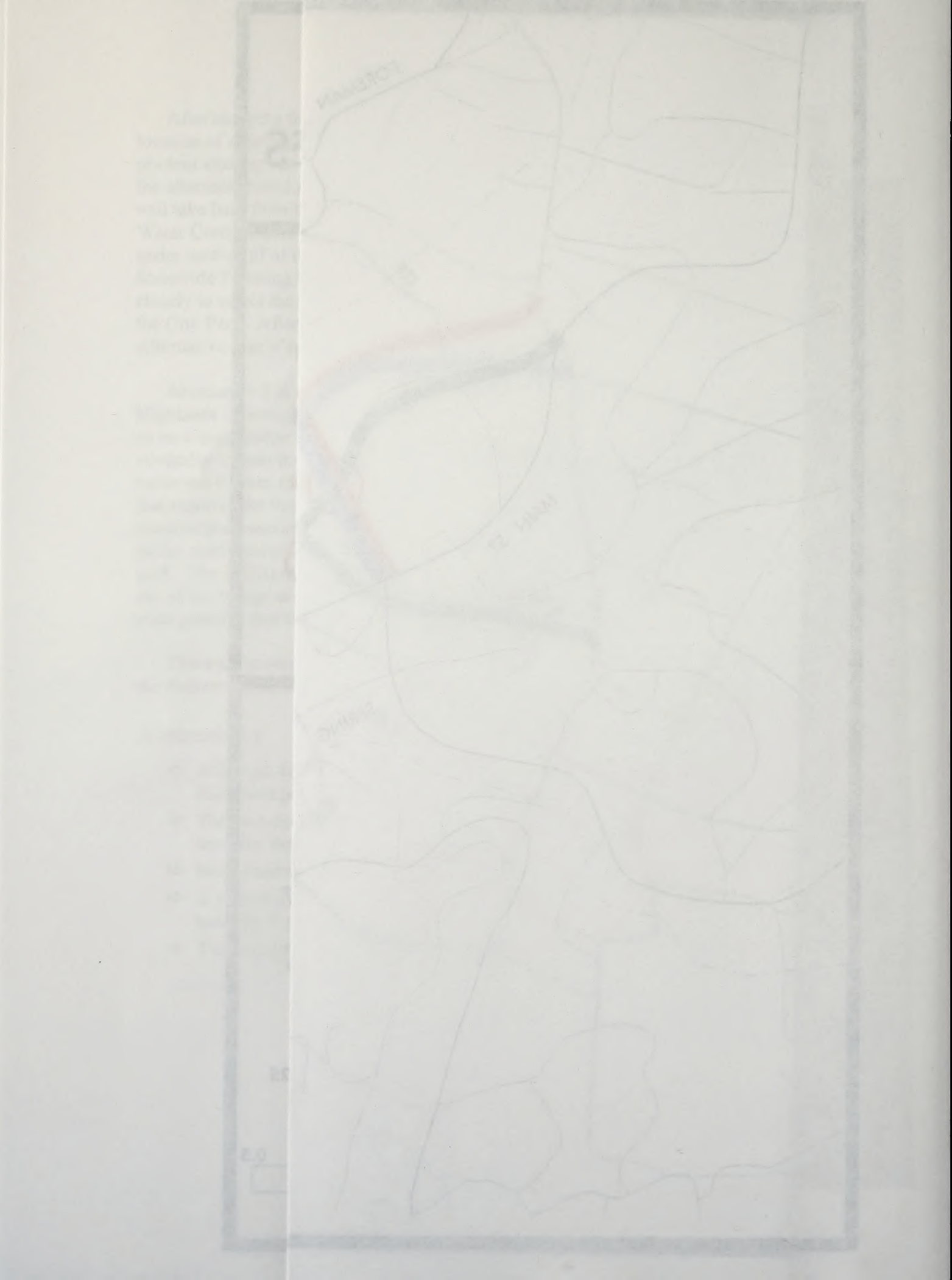
3RD
PROJECT ALTERNATIVES
LEGEND
ALT #1
ALT #2
ALT #3
GRADE SEPARATION
FIGURE 3
DOWNTOWN HIGHLANDS
SCALES
0
0.125
0.25
miles
0
0.25
0.5
kilometers



Alternative 2

- ⇨ This alternative does not provide as direct a bypass route as the recommended alternative because it uses Foreman Road to tie into US 64.
- ⇨ This alignment would have more signal delay than the recommended alternative.
- ⇨ The at grade intersection with Oak Street could change the travel patterns of the local streets in this area.
- ⇨ The grade along First Street from Main Street to Oak Street is not improved as much as in the recommended alternative.

Existing Alternative

- ⇨ This alternative takes the most park land and splits the park.
- ⇨ It would have a greater visual impact.
- ⇨ It could substantially change the nature and usage of the park.

4. Existing and Projected Conditions

Factors Affecting Transportation

The objective of thoroughfare planning is to develop a transportation system which will enable people and goods to travel safely and economically. To determine the needs of a county; population, land use, and traffic must be examined. To properly plan for the transportation needs, it is important to understand and describe the type and amount of travel which takes place in that area, and also to clearly identify the goals and objectives to be met by the thoroughfare plan.

In order to fulfill the objectives of an adequate 29-year thoroughfare plan, reliable forecasts of future travel patterns must be achieved. Such forecasts are possible only when the following major items are carefully analyzed: (1) historic and potential population changes; (2) significant trends in the economy; (3) character and intensity of land development; and (4) motor vehicle registration and usage. Additional items that vary in influence include the effects of legal controls such as zoning ordinances and subdivision regulations, availability of public utilities, transportation facilities, topographic and other physical features of the urban area.

Population Trends

The volume of traffic on a section of roadway is a function of the size and location of the population it serves. An analysis of population is one of the first steps for transportation planning. The analysis of past trends allows the planner to estimate future population and the traffic that it will generate with some degree of reliability.

From 1970 to 1995 the population of Macon County has grown approximately 2.06 percent per year; slightly greater than North Carolina's growth rate of 1.40 percent per year for the same period. This growth trend is due to the expansion of residential development, the increase in employment opportunities, and the rise in popularity of the region as a resort and retirement community. The remainder of the planning period should see a continuation of this growth trend in Highlands and Macon County.

Table 1 shows the historical and projected populations for North Carolina, Macon County, and Highlands. Table 2 shows the percent change in population for North Carolina, Macon County, and Highlands.

Table 1 Population							
	Year						
Location	1970	1980	1990	2000	2010	2020	2025
North Carolina	5,084,411	5,880,095	6,632,448	7,713,383	8,543,312	9,345,967	9,815,047
Macon County	15,788	20,178	23,499	28,507	31,647	34,259	36,305
Highlands	583	653	948	---	---	---	---

Source: Office of State Planning

Table 2 Percent Change in Population						
Location	1970-1980	1980-1990	1990-2000	2000-2010	2010-2020	2020-2025
North Carolina	+15.6	+12.8	+16.3	+10.8	+9.4	+5.0
Macon County	+27.8	+16.5	+21.3	+11.0	+8.2	+8.3
Highlands	+12.0	+45.2 *	---	---	---	---

* This dramatic increase due to a 1980 annexation that roughly doubled the land area of Highlands.

Employment

The largest employment sectors in Macon County are the service and retail trade industries. Twenty-four percent of the 1990 labor force worked in the service industry and almost 23 percent were employed in the retail trade industry. The construction and manufacturing industries, each with approximately 13 percent of the 1990 labor force, are also significant employment sectors. The trend toward more retail trade and service employment is expected to continue in Macon County. The evolution of Macon County as a retirement and resort area should continue to drive this trend. The growth in tourism to explore the natural beauty of Highlands and surrounding Macon County will also contribute to this trend. Table 3 contains a breakdown of the employment sectors in Macon County for 1990 and 2020.

Table 3
Employment Trends In Macon County

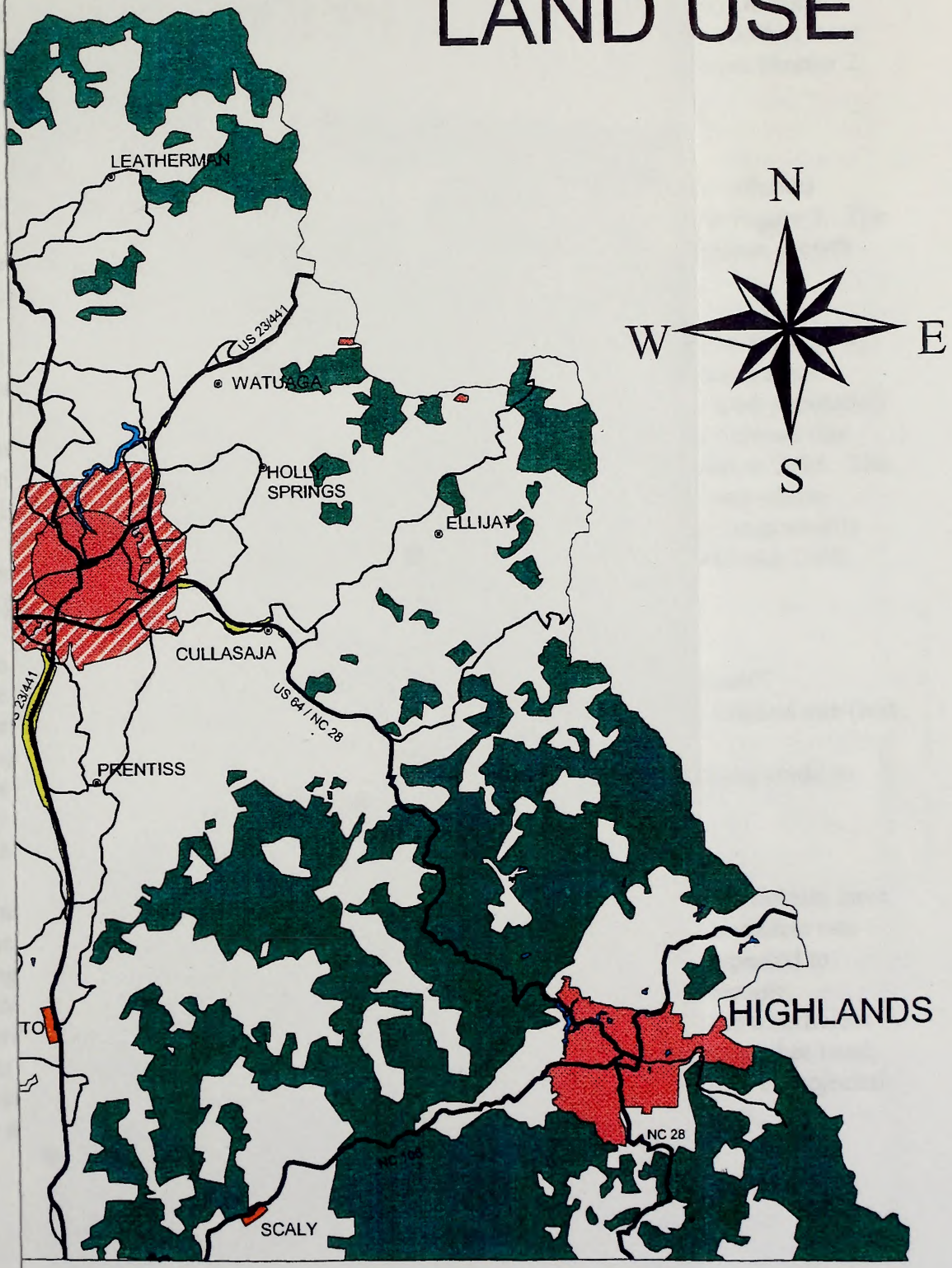
Employment Classification	1990 Employees	1990 Percent	2020 Employees	2020 Percent
Agriculture	360	3.4	270	1.7
Manufacturing	1366	12.7	1740	11.2
Non-manufacturing	9011	83.9	13570	87.1
Agricultural Services, Forestry, Mining	206	1.9	350	2.2
Construction	1384	12.9	1830	11.8
Transportation, Commerce, and Public Utilities	398	3.7	550	3.5
Retail Trade	2449	22.8	4770	30.6
Wholesale Trade	120	1.1	240	1.5
Finance, Insurance, and Real Estate	553	5.2	510	3.3
Services	2577	24.0	3780	24.3
Government	1324	12.3	1540	9.9

Sources: Regional Economic Information System, US Department of Commerce, June 1996
1996 State Profile North Carolina, Woods & Poole Economics, Inc., December 1995

Land Use

The generation of traffic on a particular street is very closely related to the utilization of adjacent land areas. Some types of land use generate much more traffic than others. For example, a commercial or retail area such as a shopping center would generate or attract much larger volumes of traffic than a residential area. The attraction between different land uses varies with the intensity of the development and the distance between those developed areas. Therefore, it becomes necessary to designate land uses by type for the purposes of transportation planning. An analysis of the distribution of existing land uses serves as a basis for forecasting future land use needs and resulting travel patterns. Figure 4 shows the existing and transitional land use for Highlands and the remainder of Macon County. Much of the new growth in Highlands will be driven by the continued evolution of the area as a tourism and retirement destination.

LAND USE



TO SCALE

FIGURE 4

Land Use

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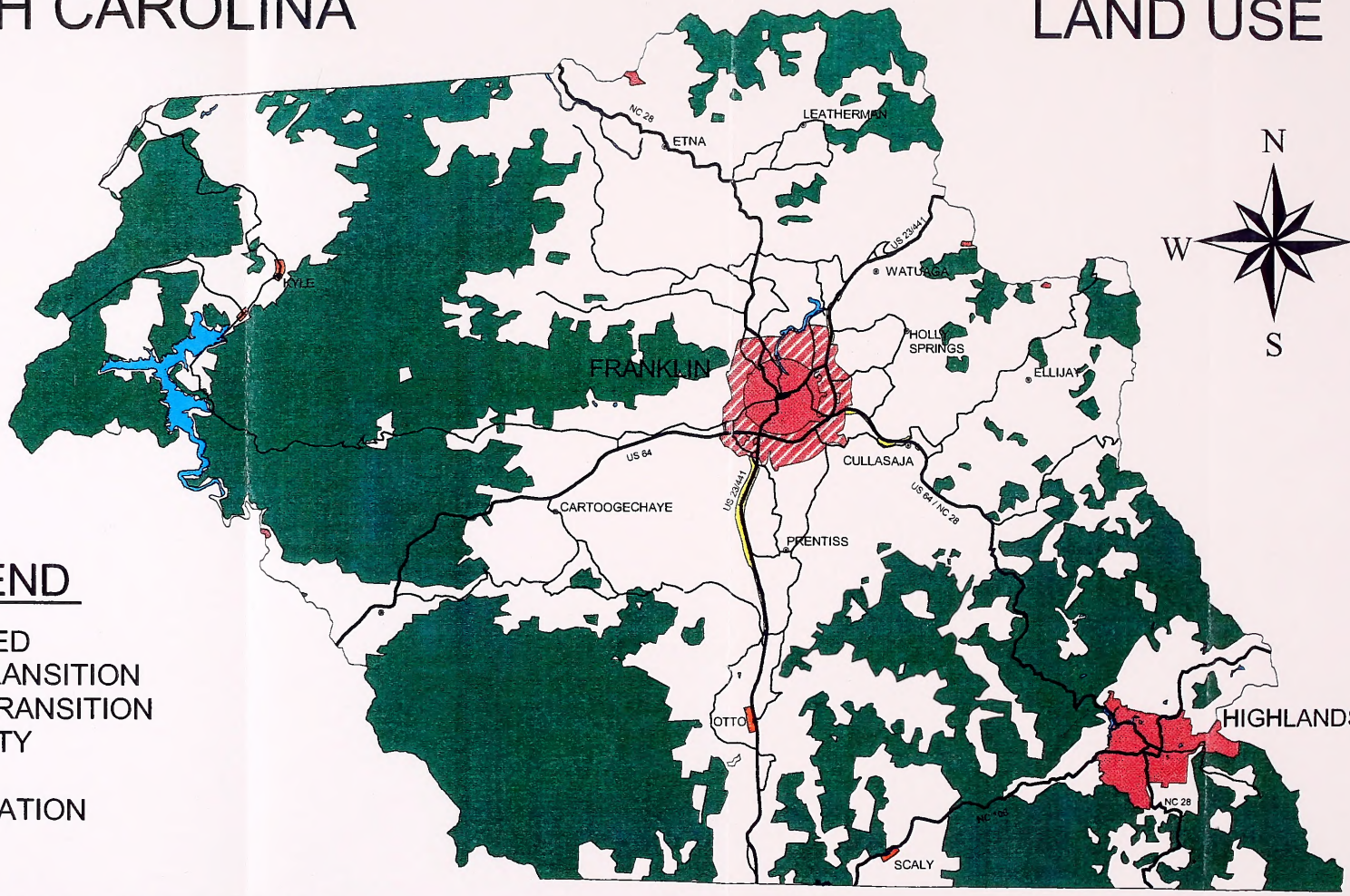
MACON COUNTY
NORTH CAROLINA

LAND USE



LEGEND

- DEVELOPED
- URBAN TRANSITION
- LIMITED TRANSITION
- COMMUNITY
- RURAL
- CONSERVATION

- LAKES
- PRIMARY US AND STATE HIGHWAYS
- SECONDARY ROADS

NOT TO SCALE

FIGURE 4

Historically Significant Land

Within the Highlands Planning Area, there are at least four sites and one historic district listed on the National Register of Historic Places. It is not anticipated that these properties would be adversely impacted by any of the recommendations from chapter 2.

Traffic

A comparison of 1996 and projected 2025 average annual daily traffic volumes (AADT) on selected major roads and highways in Highlands are shown in Figure 5. The projected AADT was based on historical and anticipated population, economic growth patterns and land use trends.

Vehicle registration has increased at a much greater rate than population since 1940. The increase can best be shown by a graph displaying the change in the persons per vehicle ratio over a period of time. This ratio is obtained by dividing the total population of the area by the total number of vehicles registered in that area. Figure 6 shows this comparison for North Carolina and Macon County and includes projections to 2025. The results illustrate the transition from a non-automobile oriented society to one whose vitality is heavily dependent on the automobile. This change in life style has gradually occurred over many years, with the most dramatic difference between 1940 and 1960. This is primarily due to the following reasons:

1) The post-depression increase in the standard of living.
2) The increase in population including the post World War II "Baby Boom".
3) The transition from an agriculturally dominated society to a more diversified one (less people on the farm, but more need for transportation).
4) The availability of automobiles in the 1960's and 1970's and the banking credit to buy them (more cars easier credit).
5) The increased number of women in the work force.

Since the early 1970's however, these reasons for purchasing more automobiles have become less influential and have led to the expectation that the person per vehicle rate will begin to stabilize as projected in Figure 6. This saturation effect is expected to stabilize trip-making characteristics of families in the middle and upper income categories due to the fact they already have the financial means to purchase a sufficient number of vehicles to satisfactorily serve their transportation needs. On the other hand, moderate growth in the trip making characteristics of lower income families is projected due to an expected improvement in their financial well-being.

Capacity, Width, and Alignment Deficiencies

North Carolina's standard for highway construction calls for 3.3 meter (11 ft) lanes on all highways with traffic volumes greater than 2000 ADT (Average Daily Traffic) or design speeds greater than 80 kilometers per hour, including all primary arterials. A minimum lane width of 2.7 meters (9 ft) can be tolerated on collector roads with an ADT of less than 400 vehicles per day. Minimum level of service for minor collector roads dictate a 40 mph average overall travel speed during peak traffic conditions.

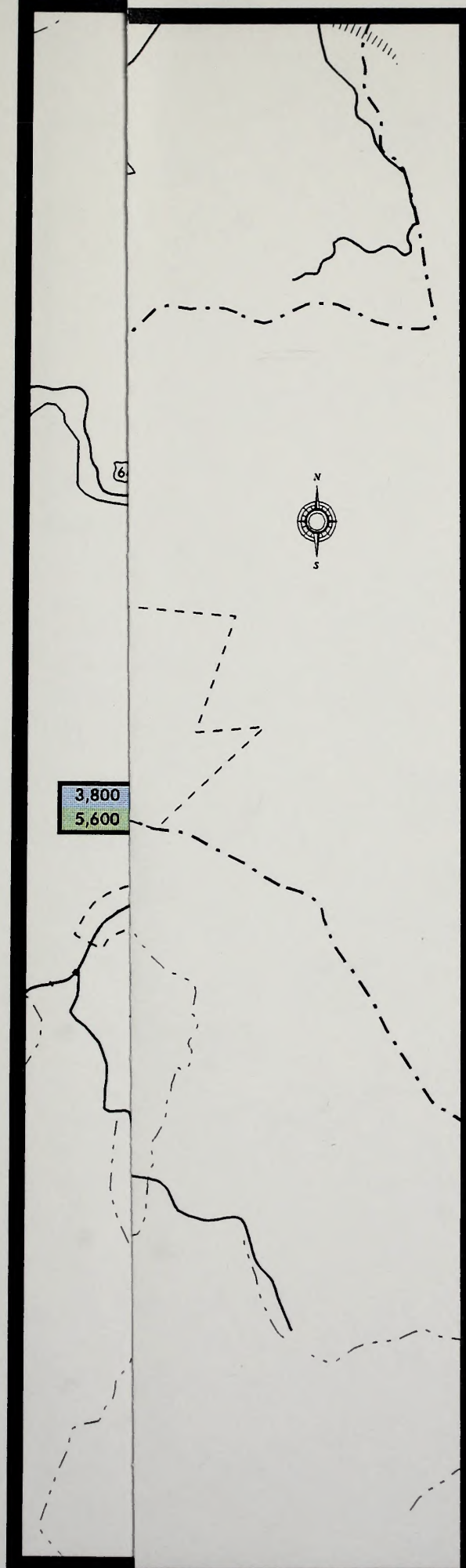
Design requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each road or highway section must be individually analyzed and its design requirements determined on the basis of the amount and type of projected traffic, existing capacity, desired level of service, and availability of right-of-way.

The level of service is a function of the ease of movement experienced by motorists using the facility. The ability of a motorist to drive at a desired speed is dependent upon the control devices, the influence and character of traffic generated by abutting property, and imposed speed restrictions. The level of service is generally indicated by the overall travel speed experienced by traffic. Minimum levels of service for roads and highways included in the Recommended Highlands Thoroughfare Plan are given in table 4.

Table 4
Minimum Levels of Service for Roads and Highways

Facility	Overall Travel Speed During Peak Traffic Conditions
Principal and Minor Arterials	80-90 km/h
Major Collector Roads	70-80 km/h
Minor Collector Roads	60 km/h

From the standpoint of driver convenience, ease of operations, and safety, it would be desirable to widen all existing roads and highways to provide a minimum lane width of 3.6 meters (12 ft). However, when considering overall statewide needs and available highway revenues, it is found that these levels of improvement applied statewide would be impractical. It is necessary, therefore, to establish minimum tolerable widths for existing roads with respect to traffic demands which would be economically feasible. Table 5 gives the widths used in determining the existing lane deficiencies in the Planning Area.



LEGEND

00,000	1996 Average Annual Daily Traffic
00,000	2025 Average Annual Daily Traffic

FIGURE 5

EXISTING & PROJECTED AADT

HIGHLANDS

MACON COUNTY
NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE

U.S.DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 0.5 1.0
miles

0 1 2
kilometers

Capacity, Width, and Alignment Deficiencies

North Carolina's standard for highway construction calls for 3.3 meter (11 ft) lanes on all highways with traffic volumes greater than 2000 ADT (Average Daily Traffic) or design speeds greater than 80 kilometers per hour, including all primary arterials. A minimum lane width of 2.7 meters (9 ft) can be tolerated on collector roads with an ADT of less than 400 vehicles per day. Minimum level of service for minor collector roads dictate a 40 mph average overall travel speed during peak traffic conditions.

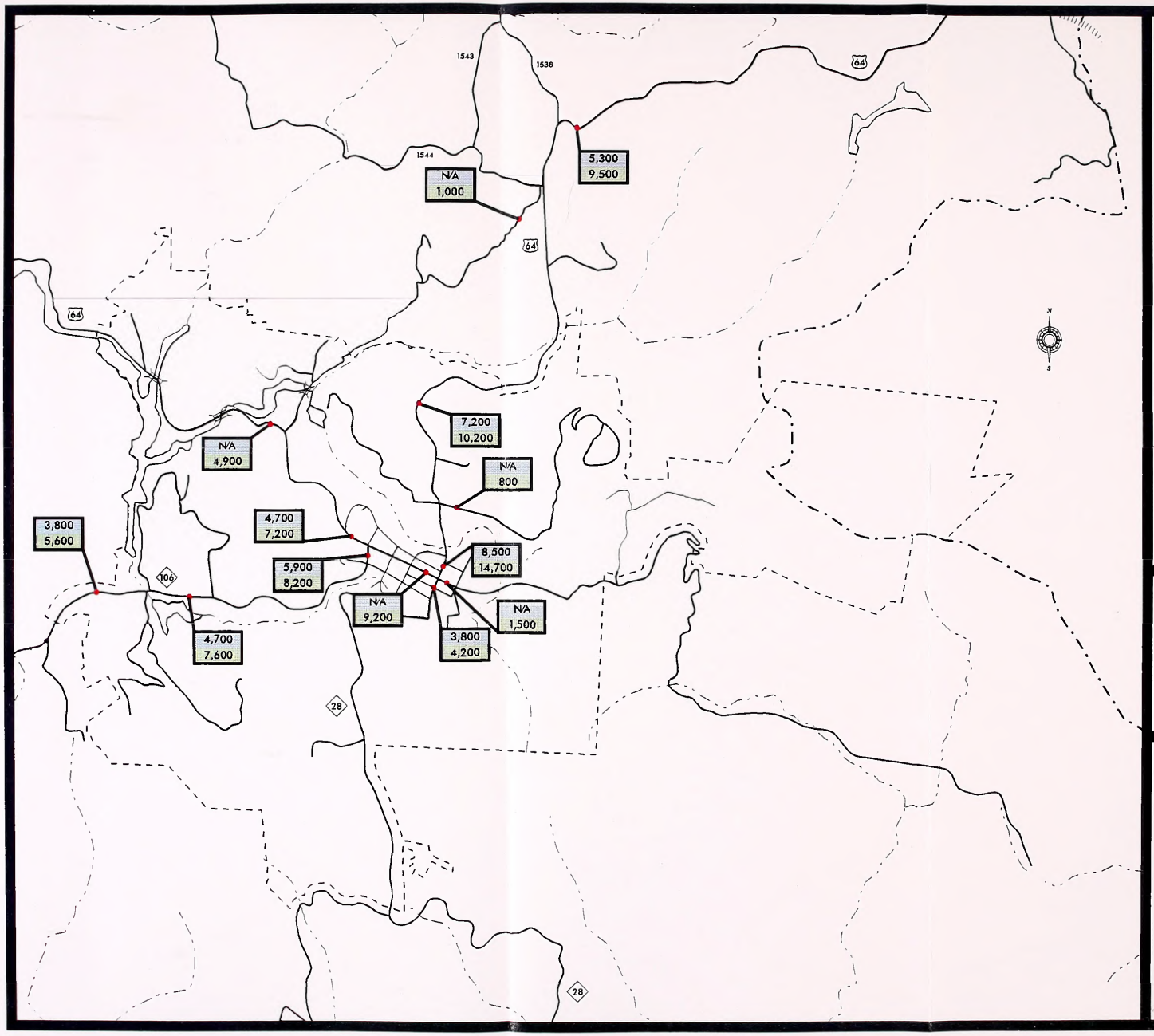
Design requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each road or highway section must be individually analyzed and its design requirements determined on the basis of the amount and type of projected traffic, existing capacity, desired level of service, and availability of right-of-way.

The level of service is a function of the ease of movement experienced by motorists using the facility. The ability of a motorist to drive at a desired speed is dependent upon the control devices, the influence and character of traffic generated by abutting property, and imposed speed restrictions. The level of service is generally indicated by the overall travel speed experienced by traffic. Minimum levels of service for roads and highways included in the Recommended Highlands Thoroughfare Plan are given in table 4.

Table 4
Minimum Levels of Service for Roads and Highways

Facility	Overall Travel Speed During Peak Traffic Conditions
Principal and Minor Arterials	80-90 km/h
Major Collector Roads	70-80 km/h
Minor Collector Roads	60 km/h

From the standpoint of driver convenience, ease of operations, and safety, it would be desirable to widen all existing roads and highways to provide a minimum lane width of 3.6 meters (12 ft). However, when considering overall statewide needs and available highway revenues, it is found that these levels of improvement applied statewide would be impractical. It is necessary, therefore, to establish minimum tolerable widths for existing roads with respect to traffic demands which would be economically feasible. Table 5 gives the widths used in determining the existing lane deficiencies in the Planning Area.



LEGEND

00,000 1996 Average Annual Daily Traffic
00,000 2025 Average Annual Daily Traffic

FIGURE 5

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FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 0.5 1.0
miles

0 1 2
kilometers

Figure 6
Macon County vs. North Carolina
Persons per Vehicle

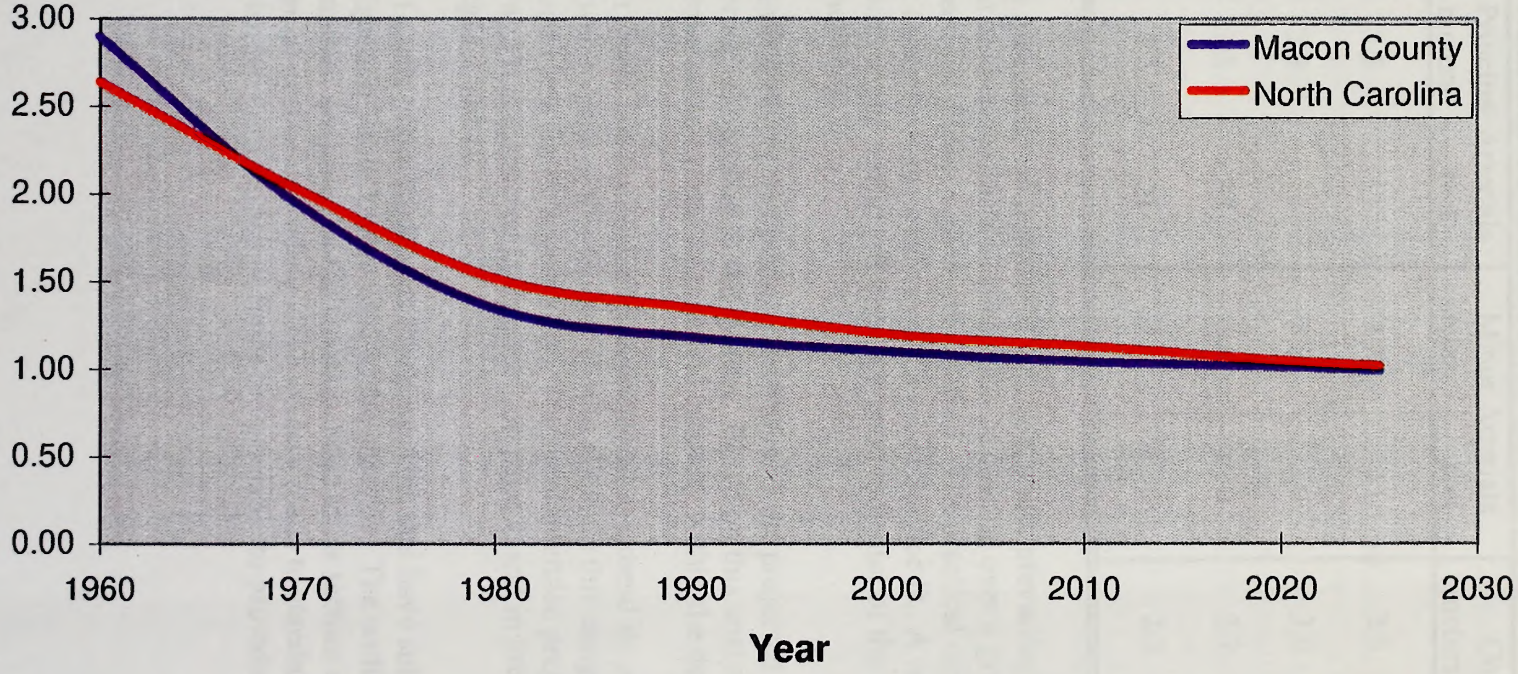


Table 5 Minimum Tolerable Lane Widths						
Average Daily Traffic (ADT)	Principal Arterials		Minor Arterials		Collectors	
	meters	feet	meters	feet	meters	feet
Over 2000	3.3	11	3.3	11	3.3	11
400 - 2000	3.3	11	3.0	10	3.0	10
100 - 400	3.3	11	3.0	10	2.7	9
Below 100	3.3	11	3.0	10	2.7	9

Capacity is defined as the maximum number of vehicles, under prevailing roadway and traffic conditions, that have a reasonable expectation of passing over a given roadway section in one or both directions during a given time period. The practical capacity of a roadway is defined as the capacity of the roadway at Level of Service D. A comparison of the practical capacity with actual traffic volumes is a good indicator of the adequacy of the existing major street network.

An analysis of roads in Highlands was made to determine if the projected traffic (year 2025) would exceed the practical capacity of the system. Based on this analysis only one facility in Highlands is projected to exceed its practical capacity within the design period.

1. US 64 along Main Street and Fourth Street is projected to exceed its practical capacity. A proposed bypass of this facility should alleviate this congestion and provide an improved route for through traffic. The recommended project is called Mill Creek Parkway. It is discussed in chapter 2 on page 5, and in greater detail in chapter 3 on pages 9 and 10.

There are a number of roads in the Highlands Planning Area that have substandard widths. Standards established in Table 5 were used in the analysis. The width needed to bring these roads up to standard are given as the recommended cross section in Appendix B. Because of the substantial cost of upgrading all secondary roads to standard; narrow widths may have to be tolerated until sufficient funds are available to provide for improvements.

Traffic Safety

Records of traffic accidents are of assistance in locating problem areas on the highway system. The 1996 safety program listing, obtained from the Traffic Engineering Branch of the North Carolina Department of Transportation, is a tabulation of accident locations throughout the state.

Traffic accident data for the period from January, 1994, through December, 1996, was analyzed as part of the development of the thoroughfare plan. Certain prevailing conditions are: intersections geometrics, sight distance, signalization, road conditions, weather, light conditions, driver's conditions and accident type. An intersection with more than 10 accidents in a 3 year period is designated as a high accident location.

An analysis of the accident reports for the Highlands area identified no high accident intersections within the planning area. However, the intersections along US 64 (Main Street) in town did show accidents at each of the major intersections. The proposed bypass should help to reduce these accidents by removing some of the traffic from these intersections.

5. Implementation

There are several tools which are available to a local government for use in the implementation of a Thoroughfare Plan. They are as follows:

State-Municipal Adoption of the Thoroughfare Plan

Chapter 136, Article 3A, Section 136-66.2 of the General Statutes of North Carolina provides that after development of a thoroughfare plan, the plan may be adopted by the governing body of the municipality and the Department of Transportation to serve as the basis for future street and highway improvements. The General Statutes also require that, as part of the plan, the governing body of the municipality and Department of Transportation shall reach agreement on responsibilities for existing and proposed streets and highways included in the plan. Facilities which are designated a State responsibility will be constructed and maintained by the Division of Highways. Facilities which are designated a municipal responsibility will be constructed and maintained by the municipality.

Although the Highlands Planning Board approved the Recommended Highlands Thoroughfare Plan and recommended it to the Town Council, the council chose not to proceed with the thoroughfare plan. The council felt the proposed Mill Creek Parkway (US 64 Bypass) was too large a project for a small town to get funded and constructed. They also expressed concerns and doubts about the ability to obtain the necessary right-of-way through the park. Instead of looking at other alternatives, the Town Council decided not to proceed with the thoroughfare plan.

If, in the future, the Town of Highlands decides to adopt this thoroughfare plan; then this plan would also be recommended to the NCDOT for mutual adoption. After the thoroughfare plan is mutually adopted, the Department of Transportation will initiate negotiations to determine which of the existing and proposed thoroughfares will be a Department responsibility and which will be a municipal responsibility. Chapter 136, Article 3A, Section 136-66.1 of the General Statutes provides guidance in the delineation of responsibilities. In summary, these statutes provide that the Department of Transportation shall be responsible for those facilities that serve volumes of through traffic and traffic from outside the area to major business, industrial, governmental, and institutional destinations located inside the municipality. The municipality is responsible for those facilities that serve primarily internal travel.

Unless implementation is an integral part of the transportation planning process, the effort and expense associated with developing a plan is lost. To neglect the implementation process is a three-fold loss; the loss of the capital expenditures used in developing a plan, the opportunity cost of the capital expenditures, and more importantly the loss of the benefits that would accrue from an improved transportation system.

Administrative controls and implementation tools that can aid in the implementation process are generally available to municipalities through Federal and State Legislation. These controls and tools will be discussed in this chapter. They include: Future Street Lines, Subdivision Regulations, Zoning Ordinances, Roadway Corridor Official Maps, Urban Renewal, Land Use Controls, Planned Urban Development Ordinance, Functional Design, Dedication of Right-of-way with Density or Development Rights Transfer, Capital Improvements Programs, and Development Reviews.

Generally two issues play a major role in the implementation process, available finances and citizen involvement. Effective use of the controls and tools listed above are indicative of good planning and minimize the effects of limited finances and negative citizen reaction to specific elements of a plan. It is through good planning that maximum use is made of every available dollar and that citizen involvement and approval of the transportation plan is obtained.

Future Street Lines

A future street line is a designated line which indicates the extent of a future street. Requirements for a future street line ordinance are:

1. enabling legislation,
2. detailed description or survey,
3. public hearing, and
4. administrative procedure and staff to oversee the process.

A future street line ordinance differs from a setback line in a zoning ordinance. Setback lines in a zoning ordinance are based on requirements for light, air, health, etc., not for future streets.

Advantages of this tool are that it can be applied on a selective basis, it can significantly reduce right-of-way costs over a long period of time, can reduce disruption to existing development, and affected property owners know what to expect. The best use for future street lines is along existing major streets that may need to be widened in the future. Care must be exercised to ensure that a future street line does not make a piece of property unusable. Future street lines should generally not be used in undeveloped areas since the manner in which land will develop can not always be anticipated.

Subdivision Regulations

Subdivision regulations are locally adopted laws governing the process of converting raw land into building sites. From the planner's view, subdivision regulations are important at two distinct levels. First, they enable the planner to coordinate the otherwise unrelated plans of many individual developers. This process assures that provision is made for land development elements such as roadway right-of-way, parks, school sites, water lines, sewer outfalls, and so forth. Second, they enable the planner to control the internal design of each new subdivision so that its pattern of streets, lots, and other facilities will be safe, pleasant, and economical to maintain.

To be most effective, subdivision regulations and their administration must be closely coordinated with other local governmental policies and ordinances. Among the more important of these are the Comprehensive Growth Plan, Utilities Extension Master Plan, CAMA Land Use Plan, and Thoroughfare Plan.

In practice, subdivision regulations can provide some very positive benefits such as requiring portions of major streets to be constructed in accordance with the Thoroughfare Plan, or requiring subdividers to provide for the dedication and/or reservation of rights-of-way in advance of construction. These practices reduce the overall cost of the plan by having some costs borne by developers. Recommended Subdivision Ordinances are included in Appendix D.

Zoning Ordinances

Zoning is probably the single most commonly used legal device available for implementing a community's land-use plan. To paraphrase the U.S. Department of Commerce 1924 Standard Zoning Enabling Act, on which most present-day legislation is based, zoning may be defined as the division of a municipality (or other governmental unit) into districts, and the regulation within the districts of:

1. the height and bulk of buildings and other structures,
2. the area of a lot that may be occupied and the size of required open spaces,
3. the density of population, and
4. the use of buildings and land for trade, industry, residence, or other purposes.

The characteristic feature of the zoning ordinance that distinguishes it from most other regulations is that it differs from district to district, rather than being uniform throughout a city. Thus, a given area might be restricted to single-family residential development with minimum lot size requirements and setback provisions appropriate for development. In other areas, commercial or industrial development might be permitted, and regulations would be enacted to control such development. Building code provisions or sanitary regulations, on the other hand, normally apply to all buildings in a certain category regardless of where they may be situated within a city.

The zoning ordinance does not regulate the design of streets, utility installation, the reservation or dedication of parks, street rights-of-way, school sites, and related matters. These are controlled by subdivision regulations or possibly by use of a Roadway Corridor Official Map. The zoning ordinance should however, be carefully coordinated with these and other control devices.

Roadway Corridor Official Map

The roadway corridor official map (or official street map) is a document, adopted by the legislative body of the community or the North Carolina Board of Transportation, that pinpoints and preserves the location of proposed streets against encroachment. In effect, the official map serves notice on developers that the State or municipality intends to acquire specific property. The official map serves as a positive influence for sound

development by reserving sites for public improvements in anticipation of actual need.

Official maps place restrictions on private property. These restrictions are in the form of a prohibition, for up to three years, on the issuance of building permits or the approval of subdivisions on property lying within an official map alignment. The three year reservation period begins when a request for development is denied. This authority should be used carefully and only in cases where less restrictive powers are found to be ineffective.

Requests for NCDOT to prepare and adopt an official map should be sent to the Director of Planning and Programming. For cities contemplating the adoption of an official map, there are two ways in which the city may proceed. The first is to consider the official map statute as a stand-alone authority and use it as the basis for local adoption of an official map. Alternatively, the second approach is to adopt a local ordinance modeled after the statute, but modified to fit local circumstances and clarify the statute. Regardless of the approach taken, several procedural steps will need to be considered, such as establishing procedures for consideration of variance petitions.

Once the project has been selected and the alignment determined, maps must be prepared that are suitable for filing with the County Register of Deeds Office. The map should show the proposed alignment in sufficient detail to identify the functional design and the preliminary right-of-way boundaries. Since the purpose of the map is to show the effect on properties along the project path, the existing property boundaries should be identified. As an additional requirement, within one year of the adoption of an official map, work must begin on an environmental document or preliminary engineering.

It is important to recognize the risks inherent in the adoption of an official map prior to completing the environmental studies. Projects to be funded using any federal funds require the unbiased evaluation of alternate alignments. This means that other alternatives can be studied and compared to the protected alignment.

The above information is only to serve as an introduction to official maps, and in no way provides the information necessary to begin development of an official map. Cities considering Official Street Map projects should contact this Branch for their "Guidelines for Municipalities Considering Adoption of Roadway Corridor Maps" at:

Director of Planning and Programming
NC Department of Transportation
P.O. Box 25201
Raleigh, North Carolina 27611

Urban Renewal

Urban renewal plays a minor role in the transportation planning implementation process in terms of scope and general influence. However, under the right circumstances, renewal programs can make significant contributions. Provisions of the New Housing Act of 1974 (as amended) call for the conservation of good areas, rehabilitation of declining areas, and clearance of slum areas.

In the course of renewal, it is important to coordinate with the Thoroughfare Plan to see if additional set-back or dedication of right-of-way is needed. Continued use of the urban renewal programs to improve the transportation system is encouraged. Changes that can be made under this program are generally not controversial or disruptive given the trauma of the clearance of a significant area.

Land Use Controls

Land use regulations are an important tool in that they regulate future land development and minimize undesirable development along roads and highways. The land use regulatory system can improve highway safety by requiring sufficient building setbacks to provide for adequate sight distances and by requiring off-street parking.

Planned Unit Development Ordinance

Planned unit development ordinances (PUD) permit flexibility in design of larger developments, with the overall design subject to review. This ordinance can require right-of-way dedication and thoroughfare construction in accordance with the thoroughfare plan. Certain revisions may be necessary to the thoroughfare plan in order to coordinate with the development.

Functional Design

The term "functional design" is used to describe preliminary design work done to answer questions on construction feasibility, to provide better information on right-of-way and construction cost estimates, and to give the administrative agency, developers and property owners a detailed knowledge on proposed alignments. Typically, functional designs are done on topographic mapping and the centerline, horizontal curves, and approximate right-of-way limits are shown to scale. If topographic mapping is not available, functional designs are done on aerial photography or planimetric mapping.

Functional designs are expensive and time consuming and can become outdated quickly due to minor changes and adjustments. For this reason, they should only be done on an "as needed" basis.

Dedication of Right-of-way with Density or Development Rights Transfer

North Carolina General Statutes have been amended to provide this additional tool for plan implementation. The statutes provide that a city or county may require an applicant for subdivision approval (or any other applicant for permission pursuant to a land use control ordinance) to dedicate the right-of-way within a corridor for street or highway purposes. The city or county upon dedication allows the applicant to transfer density credits, attributable to the dedicated right-of-way, to the contiguous land owned by the applicant.

If the city or county does not require dedication of right-of-way under this section or other legal authority, but an applicant elects to dedicate the needed right-of-way, the city or county may allow the applicant to transfer the density credits, attributable to the dedicated right-of-way, to contiguous land that is part of a common development plan or to transfer severable development rights to noncontiguous land in designated receiving districts.

Capital Improvement Programs

Capital programs are simply the coordination of planning and money. The capital improvements program, with respect to transportation, is a long range plan for the spending of money on street improvements, acquisition of rights-of-way and other improvements within the bounds of projected revenues. Municipal funds should be available for construction of street improvements which are a municipal responsibility; right-of-way cost sharing on facilities designated a Division of Highways responsibility; and advance purchase of right-of-way where such action is warranted.

Historically, cities and towns have depended, to a great degree, on Federal or State funding to solve their transportation problems. Chapter 136-Article 3A of the Road and Highway Laws of North Carolina clearly outlines the responsibilities and obligations of the various governmental bodies regarding highway improvements. North Carolina Highway Bill 1211, passed in 1988, limits the role of municipalities in right-of-way cost sharing for projects once they are programmed in the NCDOT Transportation Improvement Program. Set-back regulations, right-of-way dedications and reservations play a major role in the ultimate cost of many facilities. Only in special cases will the municipality be able to enjoy the benefits of highway improvements without some form of investment.

Development Reviews

Driveway access to a State maintained street or highway is reviewed by the District Engineer's office and by the Traffic Engineering Branch of the North Carolina Department of Transportation prior to access being allowed. Any development expected to generate large volumes of traffic (i.e., shopping centers, fast food restaurants, large industries, etc.) may be comprehensively studied by staff from the Traffic Engineering Branch, Statewide Planning Branch, and Roadway Design Branch of NCDOT. If done at an early stage, it is often possible to significantly improve the development's accessibility

at minimal expense. Since the municipality is the first point of contact for developers, it is important that the municipality advise them of this review requirement and cooperate in the review process.

Other Funding Sources

1. Assess user impact fees to fund transportation projects. These fees, called "facility fees" in the legislation, are to be based upon "reasonable and uniform considerations of capital costs to be incurred by the city or town as a result of new construction. The facility fee must bear a direct relationship to additional or expanded public capital costs of the community service facilities to be rendered for the inhabitants, occupants of the new construction, or those associated with the development process."
2. Enact a bond issue to fund street improvements.
3. Continue to work with NCDOT to have local projects included in the Transportation Improvement Program (TIP).
4. Consider the possibility of specific projects qualifying for federal demonstration project funds.
5. Adopt a collector street plan that would assess buyer or property owners for street improvement.
6. Impose a local hotel/motel tax dedicated to financing local transportation projects.

Construction Priorities

Construction priorities depend on the potential that proposed projects have to satisfy various objectives. Some of the most important objectives are:

1) improvement of the State's arterial system;
2) cost effective improvement of the safety and level of service of all roads and highways on the State system;
3) encouragement of economic development;
4) preservation of the environment; and
5) fair and equitable allocation of project funding.

Environmental Concerns

Environmental factors considered in highway project evaluation can be divided into three categories: Physical, Social/Cultural, and Economic. Factors from these categories are utilized in the benefits analysis. These primary environmental factors are shown in Table 6. The relative environmental impact of a project is subjectively measured by summing the positive and negative impacts on various environmental factors.

The economic impact of a project is an estimate of the probability that the project will stimulate economic growth in the planning area. This probability is subjectively calculated based on knowledge of the project, local development characteristics, and land development potential. The probability of economic development is then rated on a scale of 0.00 (none) to 1.00 (excellent).

Benefit Analysis

Benefits are determined based on cost savings to the users. The total benefit is the sum of the savings in three categories: Vehicle Operating Costs, Travel Time Costs, and Accident Costs. The reduction in each of these costs is the "project" benefits received by the users. The benefits produced by each project is then compared to the estimated cost of building the project. A benefit/cost analysis was performed for the Recommended Highlands Thoroughfare Plan. The results of this analysis is shown in Table 7.

Table 6
Environmental Considerations

Physical Environmental	Social and/or Cultural Environment	Economic Environment
Air Quality	Housing	Businesses
Water Resources	Neighborhoods	Employment
Wildlife	Noise	Economic Development
Vegetation	Education Facilities	Public Utilities
	Churches	Transportation Costs
	Park and Recreational Facilities	Capital Costs
	Public Health and Safety	Operation and Maintenance Costs
	National Defense	
	Aesthetics	
	Historic Sites and Landmarks	

Table 7
Highlands Thoroughfare Plan Cost Estimates - Benefits - and Probable Impacts

Description	Construction Cost	ROW [1] Cost	Total [1] Cost	User [1] Benefits	Economic Development	Environmental Impacts Positive	Environmental Impacts Negative
Mill Creek Parkway/US 64 Bypass	$6,950	$900	$7,850	$17,122	1.00	0.30	0.30
	Notes - 1 Costs and Benefits are in Thousands of Dollars. Based on these benefits. The project would pay for itself in less than 14 years.						

6. Conclusion

The economic growth of a region is largely dependent on the efficiency of its transportation system. Unless people and goods can move from one place to another quickly and conveniently, the area stagnates and fails to reach its full potential. Having recognized this need for an efficient transportation system the Town of Highlands and the North Carolina Department of Transportation cooperatively developed this thoroughfare plan. Unfortunately a mutually adopted Thoroughfare Plan was not achieved.

Although, this plan has not been adopted, it can still serve as an important planning tool for the Town of Highlands. This plan can be an effective tool in implementing an adequate future street network for the Town if approval of future land development is coordinated with the thoroughfare plan. It is also recommended that the growth patterns be monitored over time in order to detect development patterns different than those anticipated during the planning process. As a result, it may be necessary to change the implementation schedule of some of the plan. It may also be necessary to make revisions to the plan in order to accommodate unexpected changes in urban development.

A. Thoroughfare Planning Principles

There are many advantages to thoroughfare planning, but the primary mission is to assure that the road system will be progressively developed to serve future travel desires. Thus, the main consideration in thoroughfare planning is to make provisions for street and highway improvements so that, when the need arises, feasible opportunities to make improvements exist.

Benefits of Thoroughfare Planning

There are two major benefits derived from thoroughfare planning. First, each road or highway can be designed to perform a specific function and provide a specific level of service. This permits savings in right-of-way, construction, and maintenance costs. It also protects residential neighborhoods and encourages stability in travel and land use patterns. Second, local officials are informed of future improvements and can incorporate them into planning and policy decisions. This will permit developers to design subdivisions in a non-conflicting manner, direct school and park officials to better locate their facilities, and minimize the damage to property values and community appearance that is sometimes associated with roadway improvements.

Thoroughfare Classification Systems

Streets perform two primary functions, traffic service and land access, which when combined, are basically incompatible. The conflict is not serious if both traffic and land service demands are low. However, when traffic volumes are high, conflicts created by uncontrolled and intensely developed abutting property lead to intolerable traffic flow friction and congestion.

The underlying concept of the thoroughfare plan is that it provides a functional system of streets that permit travel from origins to destinations with directness, ease and safety. Different streets in this system are designed and called on to perform specific functions, thus minimizing the traffic and land service conflict.

Urban Classification

In the urban thoroughfare plan, elements are classified as major thoroughfares, minor thoroughfares, or local access streets.

Major Thoroughfares

These routes are the primary traffic arteries of the urban area providing for traffic movements within, around, and through the area.

Minor Thoroughfares

Roadways classified under this type collect traffic from the local access streets and carry it to the major thoroughfare system.

Local Access Streets

This classification covers streets that have a primary purpose of providing access to the abutting property. This classification may be further classified as either residential, commercial and/or industrial depending upon the type of land use that they serve.

Idealized Major Thoroughfare System

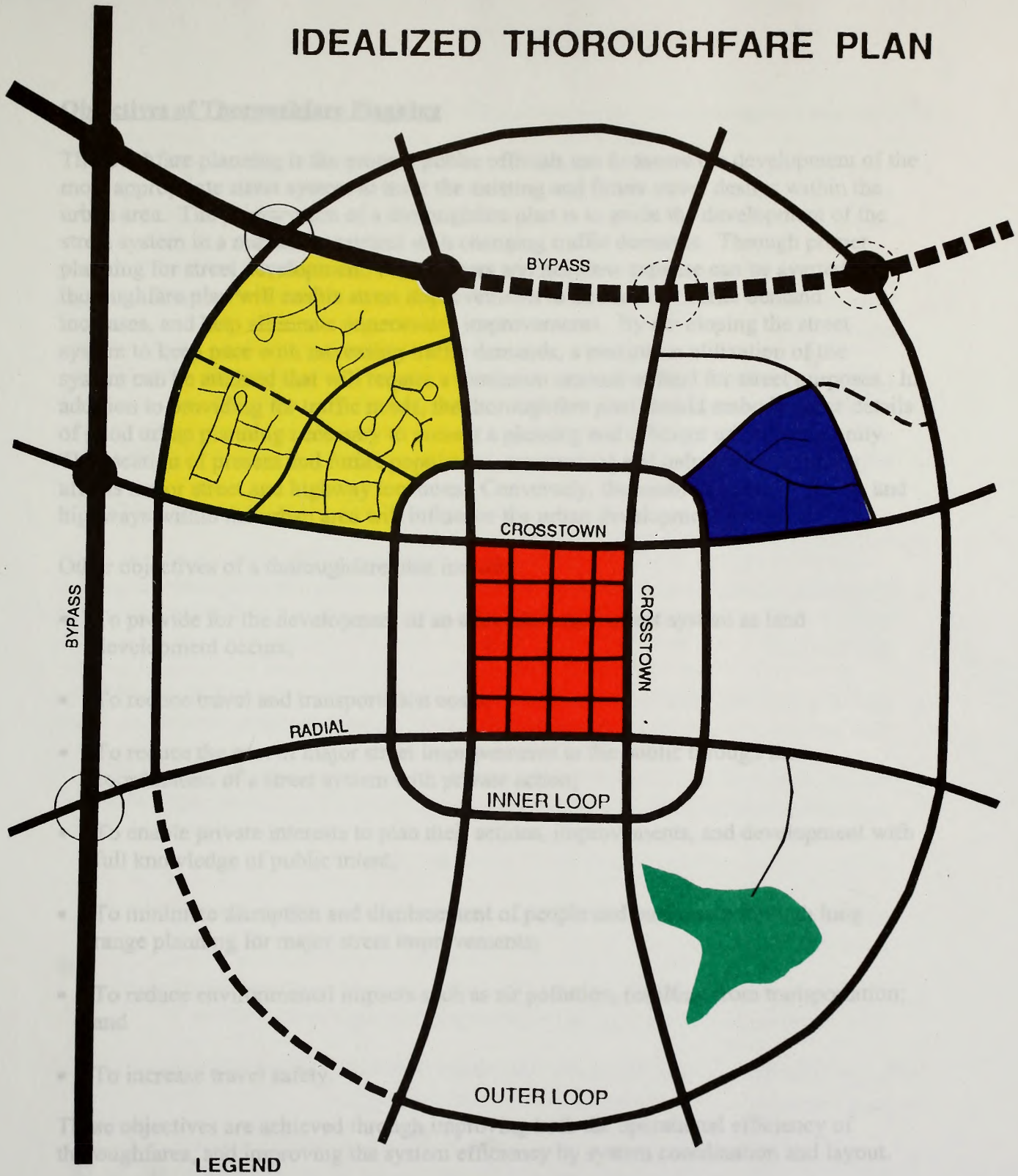
A coordinated system of major thoroughfares forms the basic framework of the urban street system. A major thoroughfare system which is most adaptable to desire lines of travel within an urban area is the radial-loop system. This system permits movement between various areas of the city with maximum directness. The functional elements of this system, shown in Figure 7, include radial streets, crosstown streets, loop system streets, and bypasses.

Radial streets service traffic movement between points located on the outskirts of the city and the central area. This is a major traffic movement in most cities, and the economic strength of the central business district (CBD) depends upon the adequacy of this type of thoroughfare.

If all radial streets crossed in the central area, an intolerable congestion problem would result. To avoid this, a system of crosstown streets forming a loop around the CBD is necessary. This system allows traffic to move from origins located on one side of the central area to destinations on the other side , following the border of the area. In addition, central area traffic is permitted to circle and then enter the area near a given destination. An effective crosstown system will free the central area of crosstown traffic, permitting the central area to function more adequately in its role.

Bypasses are designed to carry traffic through or around the urban area, removing traffic which has no desire to be in the city, thus providing relief to the city street system. Bypasses are normally designed to through-highway standards, with control of access. Occasionally, a bypass with low traffic volumes can be designed to function as a portion of an urban loop. A bypass will expedite the movement of through traffic, improving traffic conditions within the city. Since the local streets are freed for use by shopping and home-to-work travel, bypasses tend to increase the economic vitality of the local area.

IDEALIZED THOROUGHFARE PLAN



LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE FREEWAY		
MAJOR OTHER		
MINOR THOROUGHFARE		
LOCAL ROAD		
INTERCHANGE		
GRADE SEPERATION		

LAND USES

- COMMERCIAL/BUSINESS
- RESIDENTIAL
- INDUSTRIAL
- PUBLIC/INSTITUTIONAL

FIGURE 7


INNER LOOP
OUTER LOOP

Objectives of Thoroughfare Planning

Thoroughfare planning is the process public officials use to assure the development of the most appropriate street system to meet the existing and future travel desires within the urban area. The primary aim of a thoroughfare plan is to guide the development of the street system in a manner consistent with changing traffic demands. Through proper planning for street development, costly errors and needless expense can be averted. A thoroughfare plan will enable street improvements to be made as traffic demand increases, and help eliminate unnecessary improvements. By developing the street system to keep pace with increasing traffic demands, a maximum utilization of the system can be attained that will require a minimum amount of land for street purposes. In addition to providing for traffic needs, the thoroughfare plan should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The location of present and future population, commercial and industrial enterprises, affects major street and highway locations. Conversely, the location of major streets and highways within the urban area will influence the urban development pattern.

Other objectives of a thoroughfare plan include:

- To provide for the development of an adequate major street system as land development occurs;
- To reduce travel and transportation costs;
- To reduce the cost of major street improvements to the public through the coordination of a street system with private action;
- To enable private interests to plan their actions, improvements, and development with full knowledge of public intent;
- To minimize disruption and displacement of people and businesses through long range planning for major street improvements;
- To reduce environmental impacts such as air pollution, resulting from transportation; and
- To increase travel safety.

These objectives are achieved through improving both the operational efficiency of thoroughfares, and improving the system efficiency by system coordination and layout.

Operational Efficiency

A streets operational efficiency is improved by increasing the capability of the street to carry vehicular traffic and people. In terms of vehicular traffic, a street's capacity is the maximum number of vehicles that can pass a given point on a roadway during a given period under prevailing roadway and traffic conditions. Capacity is affected by the physical features of the roadway, nature of traffic, and weather.

Physical ways to improve vehicular capacity include:

- **Street widening** - widening a street from two to four travel lanes can more than double the capacity of the roadway by providing the traffic with additional maneuverability

- **Intersection improvements** - increasing the turning radii, adding exclusive turn lanes, and channelizing movements can improve the capacity of an existing intersection

- **Improving vertical and horizontal alignment** - reduces the congestion caused by slow moving vehicles

- **Eliminating roadside obstacles** - reduced side friction and improves a driver's field of sight.

Operational ways to improve street capacity include:

- **Control of access** - a roadway with complete access control can often carry three times the traffic handled by a non-controlled access street with identical lane widths and numbers

- **Parking removal** - increases capacity by providing additional street width for traffic flow and reducing friction to flow caused by parking and unparking vehicles

- **One-way operation** - the capacity of a street can sometimes be increased 20-50%, depending upon turning movements and street width, by initiating one-way traffic operations. One-way streets also can improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination

- **Reversible lanes** - reversible traffic lanes may be used to increase street capacity in situations where heavy directional flows occur during peak periods

- **Signal phasing and coordination** - uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operation.

Altering travel demand is a third way to improve the efficiency of existing streets. Travel demand can be reduced or altered in the following ways:

- **Carpools** - encourage people to form carpools and vanpools for journeys to work and other trip purposes; this reduces the number of vehicles on the roadway and raises the people carrying capability of the street system

- **Alternate modes** - encourage the use of alternate modes of travel such as transit, bicycles, or walking for short distance trips

- **Work hours** - encourage industries, business, and institutions to stagger work hours or establish variable work times for employees; this will reduce travel demand in peak periods and spread peak travel over a longer period

- **Land use** - plan and encourage land use development or redevelopment in a more travel efficient manner.

System Efficiency

Another means of altering travel demand is the development of a more efficient system of streets that will better serve travel desires. A more efficient system can reduce travel distances, time, and cost. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

Application of Thoroughfare Planning Principles

The concepts presented in the discussion of operational efficiency, system efficiency, functional classification, and the idealized major thoroughfare system are the conceptual tools available to the transportation planner in developing a thoroughfare plan. In actual practice, thoroughfare planning is done for established urban areas and is constrained by existing land use and street patterns, existing public attitudes and goals, and current expectations of future land use. Compromises must be made because of these and the many other factors that affect major street locations.

Through the thoroughfare planning process it is necessary from a practical viewpoint that certain basic principles be followed as closely as possible. These principles are listed below:

1. The plan should be derived from a thorough knowledge of today's travel - its component parts, and the factors that contribute to it, limit it, and modify it.

2. Traffic demands must be sufficient to warrant the designation and development of each major street. The thoroughfare plan should be designed to accommodate a large portion of major traffic movements on a few streets.

3. The plan should conform to and provide for the land development plan for the area.

4. Certain considerations must be given to urban development beyond the current planning period. Particularly in outlying or sparsely developed areas that have development potential, it is necessary to designate thoroughfares on a long-range planning basis to protect rights-of-way for future thoroughfare development.

5. While being consistent with the above principles and realistic in terms of travel trends, the plan must be economically feasible.

B. Thoroughfare Plan Street Tabulation

Facility & Section	Existing Cross-Section S. I. Units Dist (km)	Rdwy (m)	ROW (m)	English Units Dist (MI)	Rdwy (FT)	ROW (FT)	Number of Lanes	Practical Capacity Current (Future)	1996 ADT	2025 ADT	Recommended Cross-Section Rdwy (ULT)	ROW (ULT)
US 64												
West PAB - Mirror Lake Rd	1.98	5.49	24.38	1.23	18	80	2	(12000)	---	4900	7.2m	30.0m
Mirror Lake Rd - NC 106	1.16	5.49	24.38.	0.72	18	80	2	(12000)	4700	7200	7.2m	30.0m
NC 106 - Third Street	0.35	6.71	18.29	0.22	22	60	2	12000	---	---	ADQ	ADQ
Third Street - NC 28	0.21	25.60	30.49	0.13	84	100	2	12000	---	9200	ADQ	ADQ
NC 28 - Pine Street	0.13	5.49	18.29	0.08	18	60	2	8000	8500	14700	NC	NC
Pine Street - Proposed Mill Creek Parkway	0.55	6.71	24.38	0.34	22	80	2	11000	---	---	ADQ	ADQ
Proposed Mill Creek Parkway - Northern PAB	3.73	6.71	24.38	2.32	22	80	2	(12000)	6300	10000	7.2m	30.0m
Mill Creek Pkwy/US 64 Bypass												
NC 106 - Foreman Road	0.46	7.32	30.49	0.28	24	100	2	(14000)	---	7300	7.2m	30.0m
Foreman Road - US 64	0.15	7.32	30.49	0.09	24	100	2	(14000)	---	7500	7.2m	30.0m
NC 28												
Southern PAB - Satulah Road	4.65	6.10	30.49	2.89	20	100	2	9000	---	---	ADQ	ADQ
Satulah Road - Spring Street	0.13	8.53	30.49	0.08	28	100	2	12000	---	---	ADQ	ADQ
Spring Street - Church Street	0.06	15.24	30.49	0.04	50	100	2	12000	3800	4200	ADQ	ADQ
Church Street - US 64	0.08	13.11	30.49	0.05	43	100	2	12000	3800	4200	ADQ	ADQ
NC 106												
Southwest PAB - Roan Water Rd	1.67	5.49	18.29	1.04	18	60	2	(12000)	3800	5600	7.2m	30.0m
Roan Water Road - Cobb Road	0.50	5.49	18.29	0.31	18	60	2	(12000)	4700	7600	7.2m	30.0m
Cobb Road - US 64	1.48	5.49	18.29	0.92	18	60	2	(12000)	5900	8200	7.2m	30.0m

PAB - Planning Area Boundary
ADQ - Adequate
NC - No Change
MP - Mile Post
UK - Unknown

Facility & Section	Existing Cross-Section S. I. Units Dist (km)	Rdwy (m)	ROW (m)	English Units Dist (MI)	Rdwy (FT)	ROW (FT)	Number of Lanes	Practical Capacity Current (Future)	1996 ADT	2025 ADT	Recommended Cross-Section Rdwy (ULT)	ROW (ULT)
Horse Cove Road (SR 1603)												
US 64 - High Street (SR 1689)	0.16	25.60	UK	0.10	84	UK	2	12000	---	1500	ADQ	ADQ
High - 0.48 km west of Street Walkingstick Rd (SR 1608)	6.05	4.88	UK	3.76	16	UK	2	(12000)	---	---	7.2m	30.0m
0.48 km west of - 0.97 km east of Walkingstick Rd. Walkingstick Rd.	1.45	5.49	UK	0.90	18	UK	2	(12000)	---	---	7.2m	30.0m
0.97 km east of - Whiteside Walkingstick Rd Cove (SR 1606)	0.32	4.88	UK	0.20	16	UK	2	(12000)	---	---	7.2m	30.0m
Flat Mountain Rd. (SR 1544)												
US 64 - Hicks Road	0.06	5.18	UK	0.04	17	UK	2	(9000)	---	---	6.0m	18.0m
Hicks Road (SR 1545)												
Flat Mtn. Rd - Mirror Lake Rd	2.16	3.66	18.29	1.34	12	60	2	(9000)	---	1000	6.0m	18.0m
Mirror Lake Road (SR 1546)												
Hicks Rd (SR 1545) - US 64	0.72	4.88	UK	0.45	16	UK	2	(9000)	---	---	6.0m	18.0m
Chestnut Street (SR 1602)												
US 64 - Fifth Street	0.43	5.49	18.29	0.27	18	60	2	8000	---	800	ADQ	ADQ

PAB - Planning Area Boundary
ADQ - Adequate
NC - No Change
MP - Mile Post
UK - Unknown

C. Typical Cross Sections

Cross section requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each street section must be individually analyzed and its cross section requirements determined on the basis of amount and type of projected traffic, existing capacity, desired level of service, and available right-of-way. Typical cross sections recommended by the Statewide Planning Branch are shown in Figure 8. These cross sections are typical for facilities on new location and where right-of-way constraints are not critical. For widening projects and urban projects with limited right-of-way, special cross sections should be developed that meet the needs of the project.

The recommended typical cross sections shown in Appendix B, were derived on the basis of projected traffic, existing capacities, desirable levels of service, and available right-of-way.

On all existing and proposed major thoroughfares delineated on the thoroughfare plan, adequate right-of-way should be protected or acquired for the ultimate cross sections. Ultimate desirable cross sections for each of the thoroughfares are listed in Appendix B. Recommendations for "ultimate" cross sections are provided for the following:

1. thoroughfares which may require widening after the current planning period

2. thoroughfares which are borderline adequate and accelerated traffic growth could render them deficient

3. thoroughfares where an urban curb and gutter cross section may be locally desirable because of urban development or redevelopment

Recommended design standards relating to grades, sight distances, degree of curve, super elevation, and other considerations for thoroughfares are given in Appendix D.

A - Four Lanes Divided with Median - Freeway

Typical cross section for four lane divided highways in rural areas which may have only partial or no control of access. The minimum median width for this cross section is 14 m (46 feet), but a wider median is desirable.

B - Seven Lanes - Curb & Gutter

This cross section is not recommended for new projects. When the conditions warrant six lanes, cross section "D" should be recommended. Cross section "B" should be used only in special situations such as when widening from a five lane section and right-of-way is limited. Even in these situations, consideration should be given to converting the center turn lane to a median so that cross section "D" is the final cross section.

C - Five Lanes - Curb & Gutter

Typical for major thoroughfares, this cross section is desirable where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

D - Six Lanes Divided with Raised Median - Curb & Gutter / E - Four Lanes Divided with Raised Median - Curb & Gutter

These cross sections are typically used on major thoroughfares where left turns and intersection streets are not as frequent. Left turns would be restricted to a few selected intersections. The 4.8 m (16 ft) median is the minimum recommended for an urban boulevard type cross section. In most instances, monolithic median construction should be utilized due to greater cost effectiveness, ease and speed of placement, and reduced future maintenance requirements. In special cases, grassed or landscaped medians may be used in urban areas. However, these types of medians result in greatly increased maintenance costs and an increased danger to maintenance personnel. Non-monolithic medians should only be recommended when the above concerns are addressed.

F - Four Lanes Divided - Boulevard, Grass Median

Recommended for urban boulevards or parkways to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. A minimum median width of 7.3 m (24 ft) is recommended with 9.1 m (30 ft) being desirable.

G - Four Lanes - Curb & Gutter

This cross section is recommended for major thoroughfares where projected travel indicates a need for four travel lanes but traffic is not excessively high, left turning movements are light, and right-of-way is restricted. An additional left turn lane would probably be required at major intersections. This cross section should be used only if the above criteria is met. If right-of-way is not restricted, future strip development could take place and the inner lanes could become de facto left turn lanes.

H - Three Lanes - Curb & Gutter

In urban environments, thoroughfares which are proposed to function as one-way traffic carriers would typically require cross section "H".

I - Two Lanes - C&G, Parking both sides ; J - Two Lanes - C&G, Parking one side

Cross sections "I" and "J" are usually recommended for urban minor thoroughfares since these facilities usually serve both land service and traffic service functions. Cross section "I" would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

K - Two Lanes - Paved Shoulder

This cross section is used in rural areas or for staged construction of a wider multi-lane cross section. On some thoroughfares, projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time. For areas that are growing and future widening will be necessary, the full right-of-way of 30 m (100 ft) should be required. In some instances, local ordinances may not allow the full 30 m. In those cases, 21 m (70 ft) should be preserved with the understanding that the full 30 m will be preserved by use of building setbacks and future street line ordinances.

L - Six Lanes Divided with Grass Median - Freeway

Cross section "L" is typical for controlled access freeways. The 14 m (46 ft) grassed median is the minimum desirable median width, but there could be some variation from this depending upon design considerations. Right-of-way requirements would typically vary upward from 70 m (228 ft) depending upon cut and fill requirements.

M - Eight Lanes Divided with Raised Median - Curb & Gutter

Also used for controlled access freeways, this cross sections may be recommended for freeways going through major urban areas or for routes projected to carry very high volumes of traffic.

N - Five Lanes/C&G, Widened Curb Lanes ; O - Two Lane/Shoulder Section; P - Four Lanes Divided/Raised Median, C&G, Widened Curb Lanes

If there is sufficient bicycle travel along the thoroughfare to justify a bicycle lane or bikeway, additional right-of-way may be required to contain the bicycle facilities. The North Carolina Bicycle Facilities Planning and Design Guidelines should be consulted for design standards for bicycle facilities. Cross sections "N", "O", and "P" are typically used to accommodate bicycle travel.

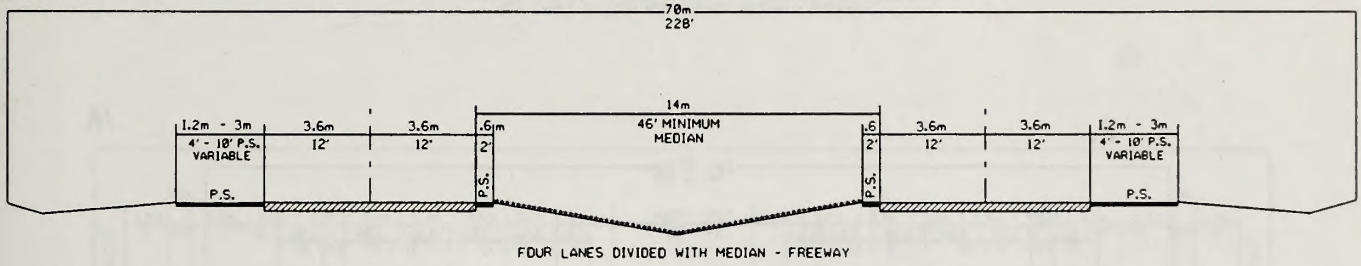
General

The urban curb and gutter cross sections all illustrate the sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum right-of-way line. This permits adequate setback for utility poles. If it is desired to move the sidewalk farther away from the street to provide additional separation for pedestrians or for aesthetic reasons, additional right-of-way must be provided to insure adequate setback for utility poles.

The right-of-ways shown for the typical cross sections are the minimum rights-of-way required to contain the street, sidewalks, utilities, and drainage facilities. Cut and fill requirements may require either additional right-of-way or construction easements. Obtaining construction easements is becoming the more common practice for urban thoroughfare construction.

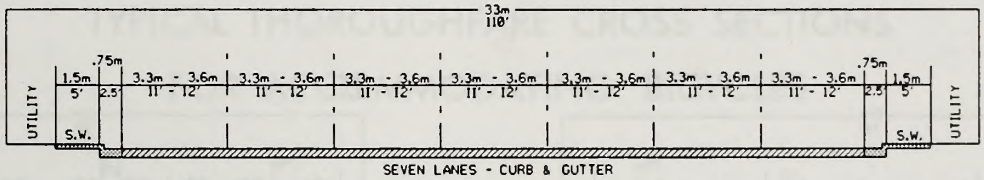
TYPICAL THOROUGHFARE CROSS SECTIONS

A.



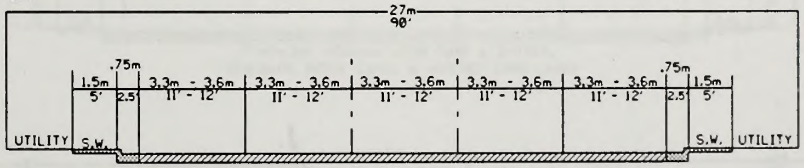
FOUR LANES DIVIDED WITH MEDIAN - FREEWAY

B.



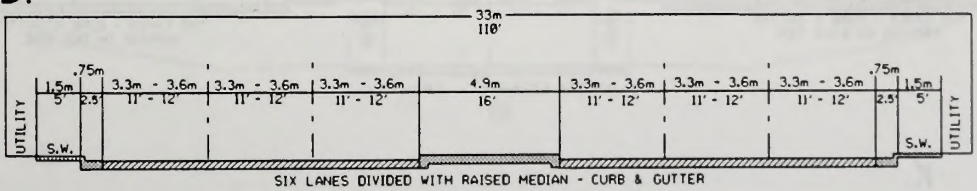
SEVEN LANES - CURB & GUTTER

C.



FIVE LANES - CURB & GUTTER

D.

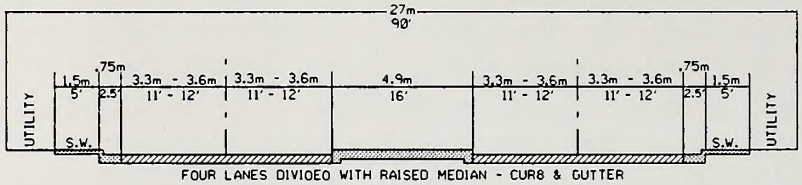


SIX LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

FIGURE 8

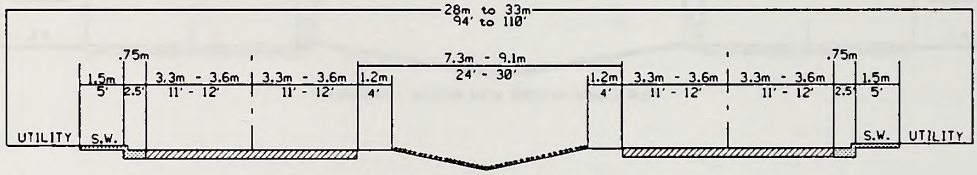
TYPICAL THOROUGHFARE CROSS SECTIONS

E.



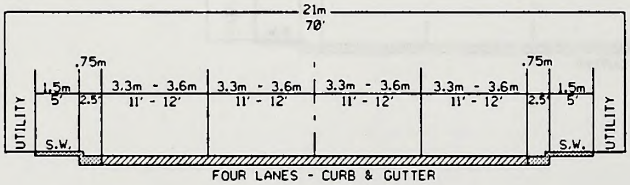
FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

F.



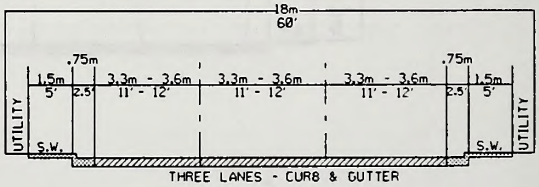
FOUR LANES DIVIDED - BOULEVARD
GRASS MEDIAN

G.



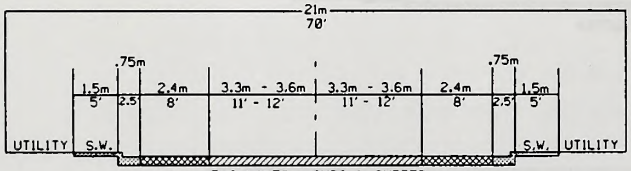
FOUR LANES - CURB & GUTTER

H.



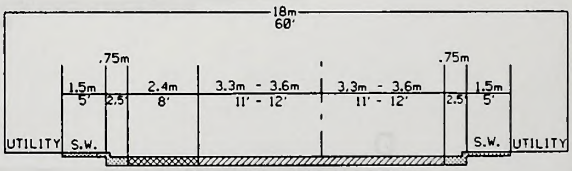
THREE LANES - CURB & GUTTER

I.



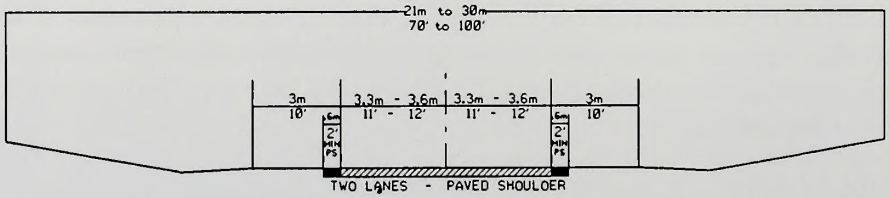
TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE

J.



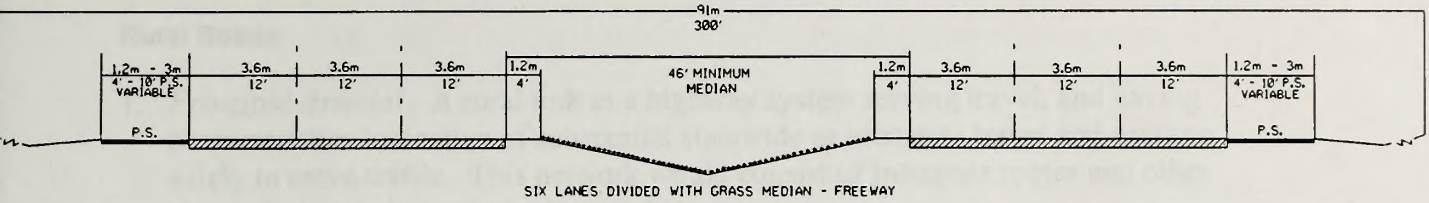
TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE

K.



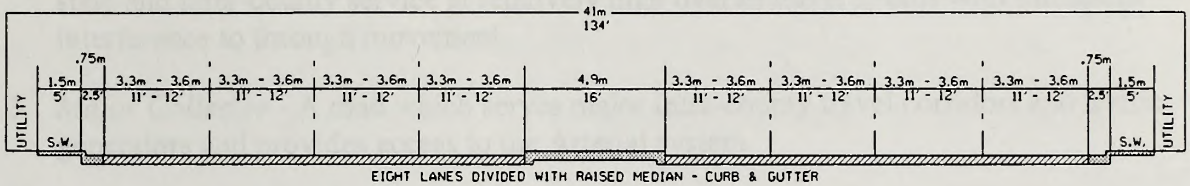
TWO LANES - PAVED SHOULDER

TYPICAL THOROUGHFARE CROSS SECTIONS



SIX LANES DIVIDED WITH GRASS MEDIAN - FREEWAY

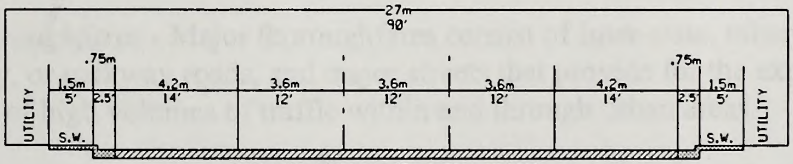
M.



EIGHT LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

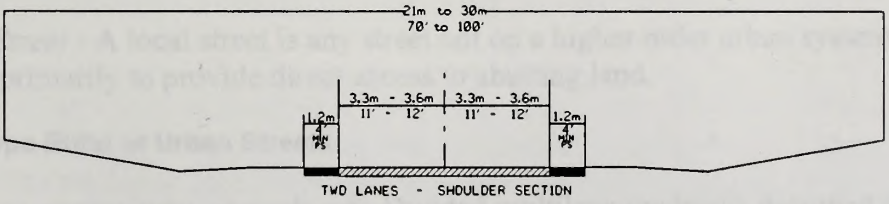
TYPICAL THOROUGHFARE CROSS SECTIONS FOR ACCOMMODATING BICYCLES

N.



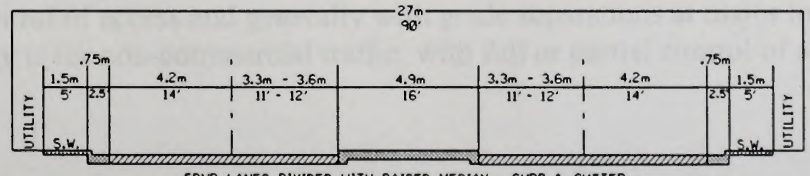
FIVE-LANE ROADWAY WITH CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

O.

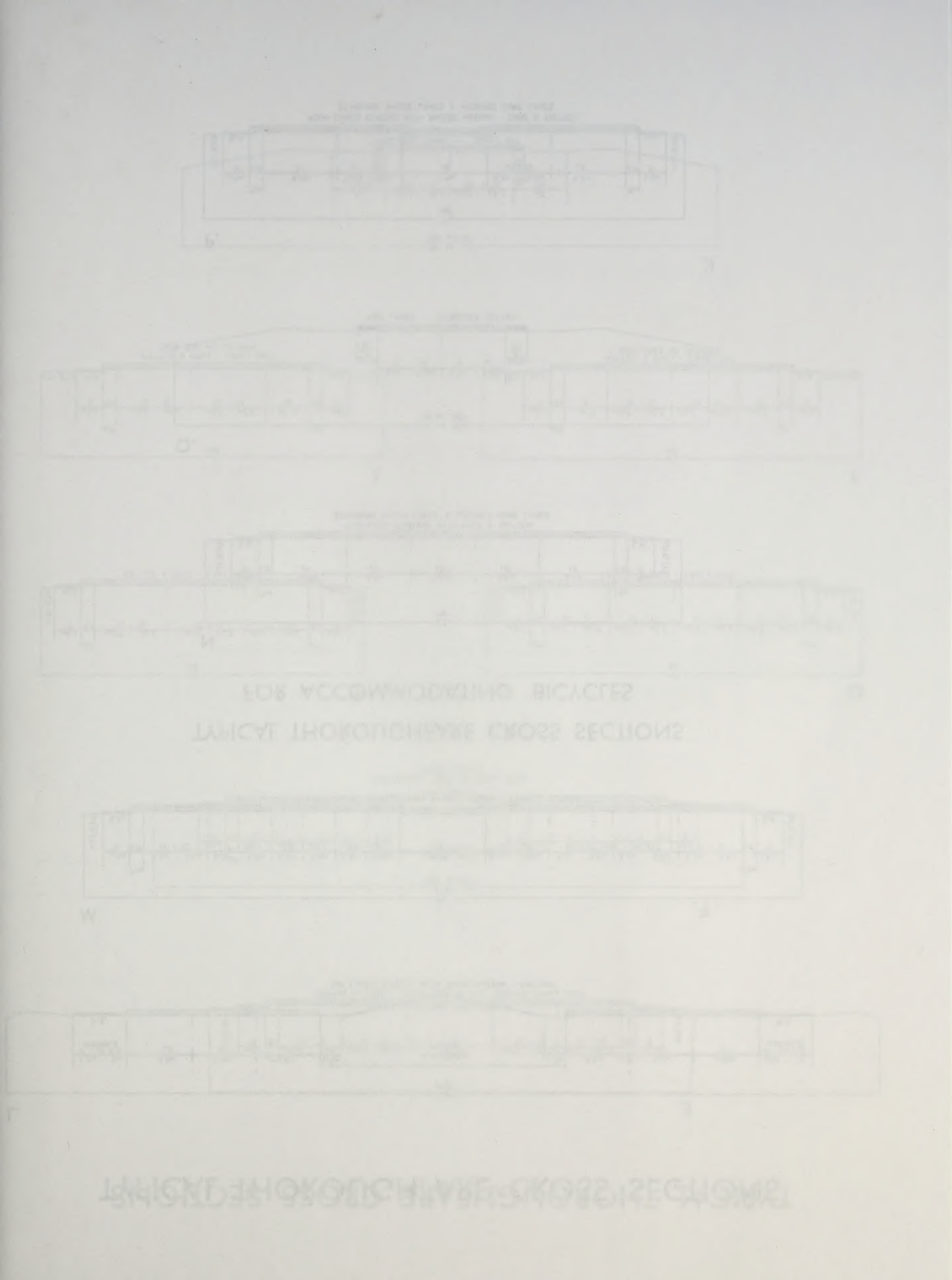


TWO LANES - SHOULDER SECTION

P.



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES



D. Recommended Subdivision Ordinances

Definitions

Rural Roads

1. *Principal Arterial* - A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of Interstate routes and other routes designated as principal arterials.

2. *Minor Arterial* - A rural roadway joining cities and larger towns and providing intra-state and inter-county service at relatively high overall travel speeds with minimum interference to through movement.

3. *Major Collector* - A road which serves major intra-county travel corridors and traffic generators and provides access to the Arterial system.

4. *Minor Collector* - A road which provides service to small local communities and traffic generators and provides access to the Major Collector system.

5. *Local Road* - A road which serves primarily to provide access to adjacent land, over relatively short distances.

Urban Streets

1. *Major Thoroughfares* - Major thoroughfares consist of Inter-state, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.

2. *Minor Thoroughfares* - Minor thoroughfares perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thoroughfare system by facilitating minor through traffic movements and may also serve abutting property.

3. *Local Street* - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

Specific Type Rural or Urban Streets

1. *Freeway, expressway, or parkway* - Divided multilane roadways designed to carry large volumes of traffic at this speeds. A *freeway* provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An *expressway* is a facility with full or partial control of access and generally with grade separations at major intersections. A *parkway* is for non-commercial traffic, with full or partial control of access.

2. *Residential Collector Street* - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collect traffic from 100 to 400 dwelling units.

3. *Local Residential Street* - Cul-de-sacs, loop streets less than 750 meters in length, or streets less than 1.5 kilometers in length that do not connect thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.

4. *Cul-de-sac* - A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn around provided.

5. *Frontage Road* - A road that is parallel to a partial or full access controlled facility and provides access to adjacent land.

6. *Alley* - A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties otherwise abutting on a street.

Property

Building Setback Line:

A line parallel to the street in front of which no structure shall be erected.

Easement:

A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

Lot:

A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. (Also includes "plat" and "parcel").

Subdivision

Subdivider:

Any person, firm, corporation or official agent thereof, who subdivides or develops any land deemed to be a subdivision.

Subdivision:

All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, immediate or future, of sale or building development and all divisions of land involving the dedication of a new street or change in existing streets.

The following shall not be included within this definition nor subject to these regulations:

- The combination or re-combination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein

- the division of land into parcels greater than four hectares where no street right-of-way dedication is involved

- the public acquisition, by purchase, of strips of land for the widening or the opening of streets

- the division of a tract in single ownership whose entire area is no greater than 0.8 hectares into not more than three lots, where no street right-of-way dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

Dedication:

A gift, by the owner, of his property to another party without any compensation being given for the transfer. The dedication is made by written instrument and completed with an acceptance.

Reservation:

Reservation of land does not involve any transfer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

Design Standards

Streets and Roads

The design of all roads within the Planning Area shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway Officials (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the recommendations of the Thoroughfare Plan, as adopted. The proposed street layout shall be coordinated with the existing street system of the surrounding area. Normally the proposed streets should be the extension of existing streets if possible.

Right-of-way Widths

Right-of-way (ROW) widths shall not be less than the following and shall apply except in those cases where ROW requirements have been specifically set out in the Thoroughfare Plan.

Table 8
Minimum Right-of-way Requirements

Area Classification	*Functional Classification*	*Minimum ROW*
RURAL	Principle Arterial	Freeways -105 meters and Other - 60 meters
	Minor Arterial	30 meters
	Major Collector	30 meters
	Minor Collector	24 meters
	Local Road	18 meters[1]
URBAN	Major Thoroughfare	27 meters
	Minor Thoroughfare	21 meters
	Local Street	18 meters[1]
	Cul-de-sac	variable[2]

[1] The desirable minimum right-of-way (ROW) is 18 meters. If curb and gutter is provided, 15 meters of ROW is adequate on local residential streets.

[2] The ROW dimension will depend on radius used for vehicular turn around. Distance from edge of pavement of turn around to ROW should not be less than distance from edge of pavement to ROW on street approaching turn around.

The subdivider will only be required to dedicate a maximum of 30 meters of ROW. In cases where over 30 meters of ROW is desired, the subdivider will be required only to reserve the amount in excess of 30 meters. On all cases in which ROW is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width ROW, not less than eighteen meters in width, may be dedicated when adjoining undeveloped property that is owned or controlled by the subdivider; provided that the width of a partial dedication be such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is subdivided, the remainder of the full required ROW shall be dedicated.

Street Widths

Widths for street and road classifications other than local shall be as recommended by the Thoroughfare Plan. Width of local roads and streets shall be as follows:

1. *Local Residential*
    - Curb and Gutter section
        - 7.8 meters, face to face of curb
    - Shoulder section
        - 6 meters to edge of pavement, 1.2 meters for shoulders
2. *Residential Collector*
    - Curb and Gutter section
        - 10.2 meters, face to face of curb
    - Shoulder section
        - 6 meters to edge of pavement, 1.8 meters for shoulders

Geometric Characteristics

The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under Right-of-Way shall apply.

1. *Design Speed* - The design speed for a roadway should be a minimum of 10 km/h greater than the posted speed limit. The design speeds for subdivision type streets are shown in Table 9.
2. *Minimum Sight Distance* - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provided and calculated using the parameters set forth in Table 10.
3. *Maximum and Minimum Grades*
    - the maximum grades in percent are shown in Table 16
    - minimum grade should not be less than 0.5%
    - grades for 30 meters each way from intersections (measured from edge of pavement) should not exceed 5%

4. *Superelevation* - Table 12 shows the minimum radius and the related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter is 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.

Table 9
Design Speeds

Facility Type	*Desirable(km/h)*	*Minimum(km/h)*	
		Level	*Rolling*
Rural			
Minor Collector Roads	100	80	70
Local Roads	80	80	70
Urban			
Major Thoroughfares	100	80	80
Minor Thoroughfares	100	80	70
Local Streets	70	70	50

Table 10
Sight Distance

Design Speed (km/h)	*Stopping Sight Distance (meters)*		*Minimum K[1] Value*	
	Minimum	*Desirable*	*Crest Curve*	*Sag Curve*
30	30	30	3	4
50	60	70	10	12
60	80	90	18	18
90	140	170	71	40
100	160	210	105	51

NOTE: General practice calls for vertical curves to be multiples of 10 meters. Calculated lengths shall be rounded up in each case.

[1]K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length in meters of the vertical curve which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordance with "AASHTO, 1990".

Table 11
Maximum Vertical Grade

Facility Type and Design Speed (km/h)	*Maximum Grade in Percent*		
	Flat	*Rolling*	*Mountainous*
Rural			
Minor Collector[1]			
30	7	10	12
50	7	9	10
60	7	8	10
90	6	7	9
100	5	6	8
110	4	5	6
Local Roads[1]			
30	-	11	16
50	7	10	14
60	7	9	12
90	6	8	10
100	5	6	-
Urban			
Major Thoroughfares			
50	8	9	11
60	7	8	10
90	6	7	9
100	5	6	8
Minor Thoroughfares[1]			
30	9	10	12
50	9	9	10
60	9	8	10
90	7	7	9
100	6	6	8
110	5	5	6
Local Streets[1]			
90	-	12	17
30	8	11	15
50	8	10	13
60	7	9	11
100	6	7	-

[1] For streets and roads with projected annual average daily traffic less than 250 or short steep grades less than 150 meters long, grades may be 2% steeper than the values in the table.

Table 12
Superelevation

Design Speed (km/h)	*Minimum Radius at Maximum e*[1]		
	e=0.04	*e=0.06*	*e=0.08*
50	100	90	80
60	150	135	125
90	375	335	305
100	490	435	395

[1] e = rate of roadway superelevation, meter per meter

Intersections

1. Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixth-five degrees.

2. Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.

3. Off-set intersections are to be avoided. Intersections which cannot be aligned should be separated by a minimum length of 60 meters between survey centerlines.

Cul-de-sacs

Cul-de-sacs shall not be more than one hundred and fifty (150) meters in length. The distance from the edge of pavement on the vehicular turn around to the right-of-way line should not be less than the distance from the edge of pavement to right-of-way line on the street approaching the turn around. Cul-de-sacs should not be used to avoid connection with an existing street or to avoid the extension of an important street.

Alleys

1. Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provisions are made for service access. Alleys shall not be provided in residential subdivisions unless necessitated by unusual circumstances.

2. The width of an alley shall be at least six (6) meters.

3. Dead-end alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turn around facilities at the dead-end as may be required by the Planning Board.

Permits for Connection to State Roads

An approved permit is required for connection to any existing state system road. This permit is required prior to any construction on the street or road. The application is available at the office of the District Engineer of the Division of Highways.

Offsets to Utility Poles

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 9 meters from the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of 1.8 meters from the face of curb.

Wheel Chair Ramps

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

Horizontal Width on Bridge Deck

1. The clear roadway widths for new and reconstructed bridges serving 2 lane, 2 way traffic should be as follows:

- shoulder section approach
    - under 800 ADT design year - minimum 8.4 meters width face to face of parapets, rails, or pavement width plus 3 meters, whichever is greater
    - 800 - 2000 ADT design year - minimum 10.2 meters width face to face of parapets, rails, or pavement width plus 3.6 meters, whichever is greater
    - over 2000 ADT design year - minimum width of 12 meters, desirable width of 13.2 meters width face to face of parapets or rails
- curb and gutter approach
    - under 800 ADT design year - minimum 7.2 meters face to face of curbs
    - over 800 ADT design year - width of approach pavement measured face to face of curbs
- where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face of curbs, and in crown drop. The distance from face of curb to face of parapet or rail shall be a minimum of 450 millimeters, or greater if sidewalks are required

2. The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic should be as follows:

- shoulder section approach - width of approach pavement plus width of usable shoulders on the approach left and right (shoulder width 2.4 m minimum, 3 m desirable)

- curb and gutter approach - width of approach pavement measured face to face of curbs

Metric Units

The following tables will be helpful to the reader in making conversions from the metric system into English units.

Table 13
Metric Conversion Table

English Units	*Metric Units*	*Abbreviation*
1 inch	25 millimeters	mm
1 foot	0.3 meters	m
1 mile	1.6 kilometers	km
1 acre	2.47 hectares	hect

Table 14
Metric Measurement Equivalents

Standard	*Equivalent*
1 millimeter	0.001 meters
1 kilometer	1000 meters
1 hectare	10,000 square meters